

SB
818
.C397
ENT

1905



AUTHOR'S EDITION
FROM ANNUAL REPORT ON EXPERIMENTAL FARMS FOR THE YEAR 1905

CANADA

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM

REPORT OF THE ENTOMOLOGIST AND BOTANIST

JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.

1905

OTTAWA
GOVERNMENT PRINTING BUREAU
1906

18345

SB
B18.
C207
ENT

AUTHOR'S EDITION

FROM ANNUAL REPORT ON EXPERIMENTAL FARMS FOR THE YEAR 1905

CANADA

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM (Ottawa, Ont.)

REPORT OF THE ENTOMOLOGIST AND BOTANIST /

JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.

1905

OTTAWA
GOVERNMENT PRINTING BUREAU
1906



INDEX

	PAGE.
Entomologist and Botanist—Report	
of the..	159-204
Acknowledgments..	160
Alfalfa affected with dodder, analysis of	203
Alfalfa Dodder..	201
Anderson, J. R., on Variegated Cutworm.	175
on Vancouver Island Oak-looper..	193
<i>Anthonomus signatus</i> ..	187
<i>Aphis brassicae</i> ..	176
Apiary, report on the..	194
season of 1905..	194
how to prevent swarming..	195
improving stock of bees..	196
queen rearing..	197
care of empty combs..	198
Wax Moth..	199
unfinished sections..	200
Apple, Woolly Aphis of the..	183
remedies for..	183
Apple Maggot..	184
Apple Worm, Lesser..	183
<i>Argyresthia</i> sp., on cedars..	189
<i>Aspidiotus perniciosus</i> ..	182
<i>Barathra occidentata</i> ..	179
Batho, Geo., on Hessian Fly..	163
Black, W. J., on cutworms in grain..	170
on grasshoppers..	171
on root and vegetable crops..	174
Black Vine Weevil..	186
Botany, Division of..	201
Bran, poisoned, for cutworms..	170
<i>Bruchus pisorum</i> ..	171
Bud-moth, Eye-spotted..	181
Buffalo Tree-hopper..	185
remedies for..	185
Burke, Rev. A. E., on cereal crops..	162
on Larch Sawfly..	191
Cabbage Aphis..	176
remedies for..	177
<i>Carpocapsa pomonella</i> ..	182
Carrot Rust-fly..	177
remedies for..	177
<i>Cecidomyia destructor</i> ..	162
<i>Cephus occidentalis</i> ..	166
<i>pygmaeus</i> ..	166
Cereal crops, 1905..	162
Cereals, insect enemies of..	162
<i>Ceresa bubalus</i> ..	185
<i>Chermes abietis</i> ..	190
Chipman, B. W., on fodder crops..	173
Chittenden, F. H., on means against the Strawberry Weevil..	188
<i>Cicada putnami</i> ..	185
<i>septendecim</i> ..	185
Clarke, G. H., on Clover Dodder..	202
Clover Dodder..	173, 201
Clover Leaf Weevil..	173
Clover Weevil, Green..	173
Clover-seed Midge..	173
Codling Moth..	182
<i>Coleophora laricella</i> ..	191
Collections of insects and plants..	160
Corn attacked by Rose Chafer..	173
attacked by Stalk Borer..	174
Corn Root Maggot..	173
Corn Worm..	175
remedies for..	175
Correspondence of the Division..	159

	PAGE.
Entomologist and Botanist—Report	
of the—Con.	
Cottony Maple Scale..	189
Criddle, N., on Western Wheat-stem Sawfly..	166
on locusts..	171
on two new garden pests..	174
Cucumber Flea-beetle..	178
remedies for..	178
Currant Maggot..	188
<i>Cuscuta epithymum</i> ..	201
<i>racemosa</i> , var. <i>chiliana</i> ..	202
<i>trifolii</i> ..	201
Cutworm, Red-backed..	169
Variegated..	175
Cutworms..	169, 173,
remedies for..	170
Diamond-back Moth..	178
remedies for..	178
<i>Diplosis tritici</i> ..	168
Dodder, Clover or Alfalfa..	201
eradication of..	204
<i>Ellopiia somnaria</i> ..	194
<i>Enarmonia prunivora</i> ..	183
Entomology, Division of..	162
<i>Entomoscelis adonidis</i> ..	177
<i>Epitrix cucumeris</i> ..	178
<i>Epochra canadensis</i> ..	188
Fir Sawfly..	189
Fixter, John, report by..	194
Flea-beetle, Red-headed..	173
Fodder crops, 1905..	172
insect enemies of..	173
Forest and shade trees, insect enemies of..	189
Fruit crops, 1905..	181
insect enemies of..	182
<i>Galeruca externa</i> ..	174
<i>Gastroidea polygoni</i> ..	174
Glendinning, H., on Turnip Aphis..	176
<i>Grapholitha prunivora</i> ..	183
Grass plots, experimental..	159
Grasshoppers..	171
Hamilton, Dr. C. A., on Turnip Aphis..	176
on Carrot Rust-fly..	177
on Potato Flea-beetle..	178
on Spined Rustic..	180
Harvest-fly, Western..	185
<i>Hemerocampa leucostigma</i> ..	193
Hessian Fly..	162
location of the injury..	164
remedies for..	165
<i>Isosoma tritici</i> ..	167
James, Prof. C. C., on fodder crops..	173
on Turnip Aphis..	176
Japing, Rudolf, on Larch Case-bearer..	192
Joint Worm..	167
remedies for..	168
Knot-weed Beetle..	174
Larch Case-bearer..	191
Larch Sawfly..	189, 190
Locust, Seventeen-year..	185
Locusts..	171
<i>Lophyrus abietis</i> ..	189
<i>Lorostege sticticalis</i> ..	179
Macoun, W. T., on strawberry varieties for planting..	187
<i>Macroductylus subspinosus</i> ..	173

	PAGE.		PAGE.
Entomologist and Botanist—Report of the—Con.		Entomologist and Botanist—Report of the—Con.	
Maple Scale, Cottony.. . . .	189	San José Scale.. . . .	182
Marmont, L. E., on Hessian Fly.. . . .	164	Sanderson, E. D., on Apple Maggot.. . . .	185
McNeil, A., on fruit crops.. . . .	181	<i>Schizoneura lanigera</i>	183
Meetings attended by the Entomologist and Botanist.. . . .	159	<i>Semasia nigricana</i>	171
by Assistant Entomologist.. . . .	160	Shutt, F. T., analysis of alfalfa affected with Dodder.. . . .	203
Miller, H. H., on Alfalfa Dodder.. . . .	202	Sleepy Weevil.. . . .	186
<i>Nematus erichsonii</i>	189, 190	Spined Rustic.. . . .	179
Nova Scotia Secretary of Agriculture, on grain crops.. . . .	162	Spruce Gall-louse.. . . .	190
Oak-looper, Vancouver Island.. . . .	193	remedies for.. . . .	190
Ontario Crop Report, on grain crops.. . . .	162	Stalk Borer.. . . .	174
<i>Otiorynchus ovatus</i>	186	Strawberry varieties recommended for planting.. . . .	187
<i>sulcatus</i>	186	Strawberry Weevil.. . . .	187
<i>Papaipema cataphracta</i>	174	remedies for.. . . .	188
<i>nitela</i>	174	Sugar Beet Webworm.. . . .	179
<i>Paragrotis ochrogaster</i>	169	<i>Systema frontalis</i>	173
Parker, S. C., on fruit crops.. . . .	181	Taylor, Rev. G. W., on <i>Therina somniaria</i>	194
Patch, Miss E. M., on Apple Maggot.. . . .	184	<i>Therina fervidaria</i>	194
'Pea Bug'.. . . .	171	<i>fiscellaria</i>	194
Pea Moth.. . . .	171	<i>somniaria</i>	189, 193
remedies for.. . . .	172	<i>Trypeta pomonella</i>	184
Pea Weevil.. . . .	171	Turnip Aphis.. . . .	176
<i>Peridroma saucia</i>	175	remedies for.. . . .	177
<i>Pimpla scriptifrons</i>	194	Turnip Beetle, Red.. . . .	177
<i>Platypedia putnami</i>	185	remedies for.. . . .	177
<i>Plutella maculipennis</i>	178	Tussock-moth, White-marked.. . . .	193
Potato Flea-beetle.. . . .	178	Webster, Prof. F. M., on Joint Worms.. . . .	168
remedies for.. . . .	178	Western Harvest-fly.. . . .	185
<i>Psila rosæ</i>	177	Wheat Midge.. . . .	168
<i>Pulvinaria innumerabilis</i>	189	remedies for.. . . .	169
Ready, Prof. J. C., on fodder crops.. . . .	173	Wheat-stem Sawfly, Western.. . . .	166
on wheat crop.. . . .	162	remedies for.. . . .	167
<i>Rhagoletes pomonella</i>	184	Willing, T. N., on cereal crops.. . . .	162
Riseborough, G. W., on Stalk Borer.. . . .	174	on Corn Worm.. . . .	176
Roots and vegetables, insect enemies of	173	Woolly Aphis of the Apple.. . . .	183
Rose Chafer attacking corn.. . . .	173	remedies for.. . . .	183
Rustic, Spined.. . . .	179		
remedies for.. . . .	180		

REPORT
OF THE
ENTOMOLOGIST AND BOTANIST
(JAMES FLETCHER, LL.D., F.L.S., F.R.S.C.)
1905.

OTTAWA, December 1, 1905.

DR. WILLIAM SAUNDERS, C.M.G.,
Director of Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to hand you herewith a report on some of the most important subjects which have been brought officially under my notice during the past season.

There is a satisfactory and ever increasing evidence of the appreciation of the value of the investigations carried on by the officers of the Division. This is indicated by the large number of letters received from farmers, fruit growers and others in all parts of Canada and by the constant demand for the services of the officers at various meetings.

The work of the Division has been during the past year of the same nature as that of previous years. Investigations have been continued of the life-histories of various insect pests, together with practical tests of the most effective remedies. In the botanical branch, the experiments with fodder plants of all kinds have been carried on as heretofore and have proved of great interest to visitors. The past season in the Ottawa district was particularly propitious for the development of grasses, clovers and other fodder plants. As some of the old plots had gradually become unproductive, it was thought well to plough up one-third of the experimental grass garden and clean it by sowing to rape. This was done early in July, and at four successive dates portions were sown and notes kept upon the crops. Next year another third of the grass garden will be treated in the same way and that part cleaned this year will be again used for grass plots. The following year the remainder will be treated.

Correspondence.—The correspondence of the Division has again during 1905 shown a considerable increase in the number of letters both received and despatched. From December 1, 1904, to November 30, 1905, the number of letters, exclusive of circulars, registered as received was 3,406 and the number despatched 3,291.

Meetings attended.—Meetings of farmers' institutes and agricultural associations of various kinds have been attended whenever other official duties would allow of absence from Ottawa.

5-6 EDWARD VII., A. 1906

December 7 to 9, 1904: Windsor, N.S.—The Fruit Growers' Association of Nova Scotia: 'Insects Injurious to Fruits in Nova Scotia.'

December 12: Amherst, N.S.—Maritime Winter Fair: 'Insects Injurious to Live Stock.'

December 29: Philadelphia.—Association of Economic Entomologists and Society for the Promotion of Agricultural Science, Annual meetings: 'Injurious Insects of 1904 in Canada'; 'A destructive Ptinid new to North America.'

February 3, 1905: Guelph.—Address before the students of the Agricultural College on 'Methods in Nature Study.'

February 4: Toronto.—Address on Nature Study and Natural History before Toronto University (Saturday afternoon Popular Lecture).

May 26: Ottawa.—Union Teachers' Convention: 'The Use of Insects in Nature Study.'

May: Ottawa.—Two addresses before the Normal School; 'Nature Study—Birds.'

June 6: Toronto.—Address before Toronto Horticultural Society on 'Insect Pests and How to Exterminate them.'

June 7: Hamilton, Ont.—Hamilton Horticultural Society: 'The Gardeners' Insect Enemies in June.'

June 8: Guelph.—Ontario Agricultural College: 'What the Experimental Farms are doing for Canada.'

June 8: Guelph.—Macdonald Institute: 'The True Place of Nature Study in Education.'

June 30: Ottawa.—Dominion Seed Growers' Association: 'Co-operation between Seed Grower and Entomologist.'

June 27: Ottawa.—Ottawa Horticultural Society: 'What Plants do.'

July 5 and 10: Ottawa.—Two addresses on Birds before Ottawa Normal School, Summer School of Science.

July 13 and 14: Ottawa.—Two addresses on Insects before Summer School of Science, Ottawa.

August 21 to Sept. 23.—Manitoba, North-west Territories and British Columbia: Holding meetings, making investigations and inspecting Fumigation Stations.

October 18 and 19: Guelph.—Attending Annual Meeting of the Entomological Society of Ontario: 'Injurious Insects of Ontario, 1905'; 'Entomological Record, 1905.' At this meeting a paper was also read by Mr. Arthur Gibson upon 'Injurious Insects of the Flower Garden.'

Mr. Gibson also attended the County of Carleton Annual Exhibition at Richmond on September 26, and judged the Natural History exhibits made by the school children of the county. These exhibits were on the whole satisfactory and showed careful work, particularly on the part of the teachers.

Collections.—The collections of insects and plants in the Division have been largely increased during the past year. Mr. Gibson, who has charge of the insect cabinets, has mounted and placed a large number of specimens. The collection of lepidoptera is now in excellent working order. Efforts will be made to build up the reference collections of the other classes of insects as quickly as possible, as information is being constantly sought for from the Division by the large number of students in all parts of the Dominion who are giving so much attention to Nature Study. Mr. Guignard has also added several hundred sheets of mounted plants to the herbarium and a large number of defective specimens have been replaced by better. Several valuable donations have been received from correspondents, of which the following are worthy of special mention:

Anderson, J. R., Victoria, B.C.—Many specimens of rare British Columbian plants.

Bilodeau, Arthur, Ottawa University.—Botanical specimen of *Hieracium murorum*.

SESSIONAL PAPER No. 16

Bush, A. H., Vancouver, B.C.—Some rare and much desired British Columbian lepidoptera.

Cockle, J. W., Kaslo, B.C.—Eggs and larvæ of interesting mountain lepidoptera.

Criddle, Norman, Aweme, Man.—Several rare western plants and moths; also seeds of weeds.

Denny, Edward, Montreal.—A beautiful series of *Apantesis vittata*, and living larvæ.

Dod, F. H. Wolley, Hillarville, Alta.—Eggs of rare western lepidoptera.

Dupret, Rev. Father H., Montreal.—Botanical specimens of the rare orchid *Epipactis viridiflora*, found at Montreal; and of *Sibbaldia procumbens*, from Mount St. Hilaire, Que.

Fraser, George, Ucluelet, B.C.—Several living plants of western ferns and other rare species of British Columbian plants, including *Apargidium boreale*, first found in Canada by Mr. Fraser.

Freeborn, J. J., Dundas, Ont.—Several samples of interesting seeds.

Gellatly, D., Gellatly, B.C.—Seeds of cut-leaved variety of *Sambucus melanocarpa* and *Ribes viscosissimum*, and specimens of the fungi which are stored by the mountain squirrels as food in winter.

Harrington, W. H., Ottawa.—Several specimens of rare Ottawa plants, some of them new to the Ottawa list.

Harvey, R. V., Vancouver, B.C.—Two specimens of *Thecla johnsoni*, a new species recently described from British Columbia; also named specimens of rare flies and other insects.

Keen, Rev. J. H., Metlakatla, B.C.—Specimens of unmounted lepidoptera.

Marmont, L. E., Rounthwaite, Man.—Larvæ of *Apantesis incorrupta* and specimens of several species of moths.

Miller, H. H., Guelph, Ont.—A beautiful collection of mounted specimens of the principal weeds with their seeds, prepared specially for seedsmen and showing all species mentioned in the Seed Control Act, 1905.

Perrin, Jos., MacNab's Island, Halifax, N.S.—A series of local forms of *Satyrus alope* and a pair of *Argynnis aphrodite*.

Stoker, Mrs., Cowichan Lake, B.C.—A collection of seeds of 130 species of British Columbian wild plants.

Venables, E. P., Vernon, B.C.—Noctuid moths from the Okanagan valley.

Willing, T. N., Regina, N.W.T.—Specimens of western moths and botanical specimens from various localities in the North-west Territories.

Young, C. H., Hurdman's Bridge, Ont.—A collection of specimens of beautifully mounted microlepidoptera, all taken at Ottawa.

I have the honour to be, sir,

Your obedient servant,

JAMES FLETCHER,

Entomologist and Botanist.

DIVISION OF ENTOMOLOGY.

CEREALS.

Cereal crops in all parts of the Dominion have been heavy and of excellent quality in 1905. The unprecedented crop of about 85 millions of bushels of wheat in Manitoba and the North-west has bountifully confirmed the sanguine anticipations of those who justly have such confidence in the Great West. Oats, barley and other grains have been equally satisfactory with the staple crop, wheat. There has been an enormous increase over 1904 in the amount of fall wheat harvested in the rich lands of southwestern Alberta. Weather conditions, although such as to cause considerable anxiety at times, from cool weather during growth, with frequent rains, proved to be most propitious for the production of high quality grain. The long open autumn allowed the enormous crop to be safely garnered.

There were few adverse influences. Rust, although locally present, had little effect on the main crop. Two weeks of hot weather just before harvest caused the grain to ripen up all at once and rather prematurely; but Mr. Willing writes at the end of the season: 'Weeds were too abundant in many places, but I have heard of no serious damage to grain crops by pests except in the early part of the season, by cutworms in Alberta and parts of Assiniboia.' In Ontario, 'while a majority of correspondents describe fall wheat as of good quality, some speak of the grain as being rather shrunken and light in weight.' 'Very little harm to the crop was reported from Hessian Fly or other insects.' (Ontario Crop Report No. 90, for Nov. 1905). In Quebec, crops were well up to the average. In New Brunswick a protracted summer drought in some parts reduced crops of all kinds, but early sown wheat threshed out a good yield.

In Nova Scotia the Secretary of Agriculture writes: 'On the whole, I think the province may be congratulated upon having received a bountiful harvest. Hay, oats, wheat and potatoes are the most important crops and have reached a high average.' In Prince Edward Island Rev. A. E. Burke reports: 'No rust of any account on grain. Wheat, oats and other grains, a bumper crop. In a very restricted circle Hessian Fly and Joint Worm attacked the wheat.' Prof. Readey writes in the August Crop Report: 'The wheat crop is above the average. In the vicinities of New London, Stanley Bridge and Cavendish, the wheat Joint Worm is reported as doing considerable damage.'

THE HESSIAN FLY (*Cecidomyia destructor*, Say).—There is little mention of injury by the Hessian Fly in Ontario during 1905, although in Prof. James's November Crop Report it is stated that a few complaints were sent to his Department; but in no case was there serious damage. Slight attack was also noticed in Prince Edward Island. A rather more considerable injury to the spring wheat crop occurred in Manitoba. Several correspondents estimate the loss at about 5 per cent. All evidence so far at hand indicates that the Hessian Fly in Manitoba is single-brooded, a fortunate fact in this country, where such a large area is devoted to wheat. In Alberta there has recently been an enormous increase in the acreage devoted to fall wheat; and, fortunately, up to the present time, no trace of the Hessian Fly has been found in that province. It will be well, however, for the fall wheat growers in the country to the south of Calgary to be on the look out for this insect and be prepared to adopt the methods of controlling it which have been so successful in the older provinces. Reports of the presence of Hessian Fly began to come in at the end of August, and through the courtesy of Mr. Geo. Batho, of the *Nor-west Farmer*, Winnipeg, I have been allowed to

SESSIONAL PAPER No. 16

consult the correspondence which was sent in to his paper on the subject. The district over which the Hessian Fly injured wheat crops to some extent, was the whole south of the province, west of the Red River, and a short way into the North-west Territories. Mr. Batho, writing on October 9, says:—

‘There was some loss due to the Hessian Fly over a large area in the southern part of the province; some fields about Morden, Roland and Carman were badly struck; but the attack was not general in all fields in any other part of the country. From most of our reports it would appear that the heavy crops escaped, but the light ones were always likely to be attacked. It seems to me that this can be explained by the heavy crops occurring on land which had been summer-fallowed, and where consequently no flies had wintered over, while the light crops were on stubble land that had been cropped last year and which might have been affected to some extent, although the injury was not noticed.’

‘Nov. 22.—I have found out since I last wrote, that the loss from the Hessian Fly is probably greater than one might suppose from any reports that have been published. A farmer at Griswold told me the other day that there was considerable loss in that district. At Portage la Prairie there was heavy loss, and one farmer stated his belief that there was a small amount of loss every year and had been for several seasons past.’—GEO. BATHO.

There is little doubt that loss from the Hessian Fly was larger than was generally recognized; but, owing to the heavy crop of wheat all through the country, little attention was paid to this matter. Unfortunately, many of the farmers of the West take the mistaken view of the subject that is expressed in a letter upon this outbreak, published in the *Nor-west Farmer* of September 5 last, where the writer says: ‘I think the estimate of 5 per cent not too high for the loss. Where I am cutting, I expect 35 or 40 bushels per acre, so I do not kick about a little loss.’ The writer evidently does not appreciate that the little loss of this year may multiply, under favourable circumstances, into an enormous one next year. The article referred to in the *Nor-west Farmer* was very timely, and stated the facts of the case plainly and well, giving the life history of the insect, the best remedies, and concluding with the following wise statement:—

‘The principal reason why care should be taken to destroy the pupæ of the Hessian Fly this fall, is of course to prevent the possibility of a much more serious attack next year.’

The following extracts from correspondence show how widespread the attack was in Manitoba, and the probable loss:—

‘Aug. 28, Virden, Man.—Crops are apparently good; but, when the binder goes into the field, they do not show up so well. We are able, by lowering the binder, to pick up most of the grain; but the sample is not as good as the rest of the field.’—A. P. POWER.

‘Aug. 29, Pilot Mound, Man.—It seems to be all through the crop of wheat this year.’—J. S. MOFFATT.

‘Sept. 2, Wellwyn, Sask.—The insects are located between the sheath and the straw itself. The damage will amount to from two to three bushels to the acre, as it is impossible to pick up all heads with the binder.’—F. J. COLLYER.

‘Sept. 7, Reston, Man.—I first noticed the Hessian Fly at Roland. Most farmers showed no interest in the matter, saying that the trouble occurred to the same extent every year. One old Ontario farmer, however, who knew the Hessian Fly, deplored its appearance, remembering the harm that it had done in Ontario. At Miami I found a few flax seeds in a late crop and a few at Belmont and Reston. The field at Roland would average 5 per cent injury all over; but in some patches it would be more than double that.’—JOHN McBEAN.

‘Sept. 7, Portage la Prairie, Man.—I noticed damage from Hessian Fly seemed to be much worse after two days of heavy wind towards the last of cutting. Crops on

5-6 EDWARD VII., A. 1906

some of the older land were injured to the extent of 5 per cent or more. These summer-fallows on new land did not seem to be so bad.'—D. W. MCKIRDY.

'Oct. 31, Cartwright, Man.—We have a little Hessian Fly here, but some miles away further south it was very bad. I put a letter in the local paper, advising farmers to burn straw even more liberally than they have been in the habit of doing.'—E. F. HEATH.

'Sept. 7, Wellwyn, Sask.—Hessian Fly has done great harm to the wheat crop here this year.'—JOHN HISLOP.

There seems to have been no uniformity of opinion as to the crop conditions which attracted the females when they were laying eggs, some farmers stating that the heavy crops on summer-fallowed land were worst attacked, while others claimed that exactly the opposite was the case. The following letter from Mr. L. E. Marmont, who has made a study of insects and their habits is of interest:—

'Nov. 28, Rounthwaite, Man.—I regret to say that the damage in this neighbourhood from Hessian Fly during the past summer was the worst since 1902. On summer-fallows, where the wheat was heaviest, there were so many broken down straws that it interfered with the proper working of the binder. Cutting had to be done so low down to get the bent over stuff, that it resulted in long ragged sheaves and an amount of straw which made an appreciable difference in the time taken in threshing. I examined straws in many fields and found from three to five flax-seeds at a joint. Many of these, I found, were very light and apparently dead. We had some extremely warm days during harvest, and this may have affected some of them. The wheat itself in injured stems was almost as plump as the unaffected; so, we cut as low as possible so as to get it. I have urged all my neighbours to try and burn their stubble, if possible; but the fall has not been very favourable in this way, still a good deal has been burned over, and, if the spring is dry, more will be done then. Threshing was so slow and the ground was frozen up so early that the area of fall ploughing is the smallest ever known; consequently, little has been done in this way against the fly, and I fear we shall have a repetition of the spring damage to the young wheat, such as we had in the spring of 1903, unless the stubble is burnt over or turned down early. I think that from three to five bushels per acre would be a conservative estimate of the damage round here.'

'Dec. 8.—My son and I think that in Blyth and the surrounding district, the damage to wheat from the Hessian Fly would be about five per cent. The early sown grain would be less and the late a little more.'—G. S. CHARLESON.

The Location of the Injury.—The larvæ of the Hessian Fly attack the stems of wheat, barley and rye, either in the root shoots of fall-sown grain, in autumn as well as in spring, before the stems are formed or of spring grain in the root shoots or at the second joint above the root. The minute red eggs are laid on the leaves by very small gnats half the size of an ordinary mosquito, during June or soon after the young plants appear above the ground. The appearance of the flies and the hatching of the eggs are, however, very much influenced by weather conditions. Both of these may be accelerated by warm damp weather, or the emergence may be delayed by dry cold weather. After emerging, the mature flies pair at once, lay their eggs, and in a very few days disappear. It is claimed that the Hessian Fly does not travel very far from the field where it develops from the puparia or flax-seeds. This is an important point, indicating the necessity of treating fields which are known to have been infested to a certain extent. As soon as the little maggots hatch from the eggs, they work their way down to the base of the leaf sheaths and attack the young stem at its junction with the leaf. Frequently the stem is prevented from forming and the shoot is destroyed; but a very few days' delay in the time of the laying of the eggs or of the hatching of the larvæ, enables the stem to begin to shoot up; and, when this takes place, they nearly always develop and form an ear. In this latter case, the injury is of course much less than when the shoot is destroyed. The larvæ lie at the base of the leaf and attack the succulent tender straw just above the joint, sucking the sap and gradually forming a

SESSIONAL PAPER No. 16

more or less noticeable depression in the soft stem inside which they lie. When only one or two maggots occur on a straw the injury is not very severe and attacked stems when not knocked down by high wind at harvest time may produce fairly heavy grain. Sometimes, however, the maggots suck the sap to such an extent that the stem is killed at the point of injury and the tissues separate, when the stem falls over, displacing the flax-seeds and making them appear as if they had formed inside the stem. This was the case last season in Manitoba and caused uncertainty on the part of some observant farmers as to the identity of the insect which had done the injury. I am obliged to my correspondent, Mr. Sanford Manson, for calling my attention to this matter; for it should certainly be mentioned when describing the nature of the attack of the Hessian Fly. He writes:—

‘Nov. 23, Sperling, Man.—I send a few wheat stems that have suffered from insect attack this summer. I have just received a very welcome bulletin (No. 52) which treats of insects; but I cannot find anything which resembles it nearer than the Hessian Fly; only the description of that insect states that it is found on the outside of the stem beneath the sheath of the leaf. You will notice that this pupa is inside the stem. I spoke to a number of farmers about the matter, and they all agreed that the pupa was inside the stem. It did not seem to affect the wheat very much, as the broken down heads were as well filled as the standing ones; but in some fields the loss from breaking down so low was that the binders could not pick it up. This made considerable loss, variously estimated at from two to five bushels per acre. It seems to have been general in this district. About the last of September it was found that the pupa had developed and the grub had eaten its way out. Therefore, it is only the deserted shell, which I am sending you. Both early and late sown wheat suffered.’

The material sent showed that some of the flax-seeds were as stated inside the straw; but in these cases the injured straw was blackened from decay, and shreaded and broken up by the twisting of the straw at the time it bent and fell over. By softening the stems in water and examining them carefully, the cavity in which the larvæ had lain while active could always be traced; and, although this depression was deeply dented into the stem, it was actually on the outside of it, beneath the base of the leaf sheath. Mr. Manson and some other correspondents have referred to empty flax-seeds being found on the stems in autumn. This is an important matter as it indicates the probability that parasites or other natural enemies have been at work, and it is therefore a very hopeful sign for the future.

There are several parasites which prey upon the Hessian Fly, and their good offices in the past have been the chief cause of the sudden disappearance from infested districts of this serious enemy of the farmer. When emerging naturally, the pupa of the Hessian Fly works its way out of the brown flax-seed-like puparium and the gauzy, empty, pupa-case is left, protruding conspicuously from the end. A parasite on leaving the puparium gnaws a ragged hole which may be in any part of the puparium. In Manitoba there is only one brood of the Hessian Fly. The puparia are found in the late summer. By harvest time all the larvæ have turned to the flax-seed stage, and the flies do not emerge until the following June. A knowledge of the habits of the insect in Manitoba suggests the best remedial measures. The puparia of all the maggots which attack the root shoots in early summer, and most of those on the straw are left in the stubble fields after the wheat is cut. An effective way of disposing of these is, when it is conveniently possible, to burn over the stubbles before the following year and to plough down the land deeply before the next crop is sown. The burning will destroy a great many of the insects, and the ploughing will put them so deep down that the delicate flies, when they emerge, cannot reach the surface. In years of bad infestation a great effort should be made to get as much fall ploughing done as possible, so as to reduce the danger of infested stubble fields being left for summer-fallowing, owing to the pressure of spring work. As it is necessary to cut low to pick up fallen grain, many of the flax-seeds will be carried with the straw. At threshing

5-6 EDWARD VII., A. 1906

time most of these will fall with the rubbish beneath the machine, or will be left in the straw. All dust and screenings, therefore, should be destroyed, and all straw and small seeds should either be used up during the winter or burnt before spring. In Ontario and the eastern provinces there are two annual broods of the Hessian Fly. The flies of the first brood appear in June and lay their eggs on spring and fall wheat and on rye and barley. Of the second brood the flies appear in September and lay their eggs on fall wheat and fall rye. Wheat, barley and rye are the only known food plants of the Hessian Fly in America, and neither oats nor the grasses are attacked.

The remedies which have given the best results against the autumn brood are late sowing and careful preparation of the land, so as to induce a vigorous growth.

THE WESTERN WHEAT-STEM SAWFLY (*Cephus occidentalis*, Riley & Marlatt).—For several years the larva of a wheat-stem sawfly has done some injury to growing wheat at different places in Manitoba and the North-west Territories. It was at first supposed, from the similarity of the attack and from a few reared specimens, that the insect was the European species, *Cephus pygmaeus*, L., which had appeared suddenly in injurious numbers at Ithaca, N.Y., in 1889. This attack was treated of at length by Prof. Comstock in Cornell Agricultural College Bulletin No. 11, 1889. The following year the insect disappeared entirely, and nothing has been seen of its work from that time. In previous reports I have referred to this western sawfly as *C. pygmaeus*, but recently specimens of our North-western insect have been submitted to Prof. A. D. MacGillivray, of Cornell University, who has identified them as *Cephus occidentalis*, Riley and Marlatt. The insect has been studied by Mr. Norman Criddle, of Aweme, Man., and he has added very materially to our knowledge of the species and its work. He has discovered its native food plants and also that these are far more attractive to it than the wheat plant, which it occasionally infests.

'July 10, Aweme, Man.—I collected several specimens of the *Cephus* yesterday. They were all resting on *Agropyrum caninum*. So far, I have been unable to find them elsewhere; and, though they are always found rather plentifully around the edges of wheat or indeed anywhere, infesting the above grass, I have very seldom been able to find wheat plants attacked by them. I have not yet been able to get hold of the species which breeds in *Ammophila longifolia*; but I am confident that it will prove to be a distinct species, as the larva is very different, being quite yellow in colour, while that of the *Agropyrum* species, *C. occidentalis*, is white.'

'July 30.—I found to-day two stalks of wheat infested by *Cephus* and several stems of *Agropyrum* were found also attacked within a few feet of them. I afterwards hunted over a large area of wheat, but was unable to find another wheat plant which was infested, though any amount of *Agropyrum caninum* was found which had been attacked. In several cases the grass was in the wheat fields. I think, therefore, that the wheat being attacked must be considered an accidental occurrence. At the same time, if the grass failed for any reason to form heads, these insects might possibly develop into a pest of some magnitude.'

'Aug. 4.—Two more stalks of wheat have been found attacked by the *Agropyrum Cephus* in a place where that plant was rare. I also found it quite numerous yesterday infesting our native quack grass, *Agropyrum glaucum*, R. & S., var. *occidentale*, V. & S.'

'Aug. 6.—*Cephus occidentalis* has now been found here, feeding in the following grasses: *Agropyrum caninum*, *A. glaucum*, var. *occidentale*, and *A. tenerum*, and also in rye and wheat, the first named and possibly the second being the native food plants, the others being only occasionally attacked.'—NORMAN CRIDDLE.

From the above it is evident that several native grasses are more attractive to the Western Wheat-stem Sawfly than is wheat. Some of the above species of grasses are common in almost all parts of the West, and their occurrence may be hoped to protect wheat from serious attack under ordinary circumstances. Should the larvæ, however,

SESSIONAL PAPER No. 16

at any time occur in noticeable numbers in a growing crop of wheat, it may be remembered that they pass the winter on the fields in the bases of straws, which they have cut off before spinning the silken cocoons in which they winter over, close to the surface of the ground. The stubbles in fields which have been infested, should, therefore, be burnt over in autumn or spring, or should be ploughed down deeply before the middle of June, so as to make it impossible for the flies to work their way up to the surface. Stubble fields left for summer-fallowing should be turned down early in June; and, should the insect at any time become more destructive than it has in the past, early summer-fallowing should be practised every other year.

THE JOINT WORM (*Isosoma tritici*, Fitch).—Injuries to grain crops in Canada by Joint Worms are seldom complained of; but during the past summer there have been a few outbreaks which have been serious, although restricted as to area. These were in western Ontario and in Prince Edward Island. Mr. T. D. Jarvis, of the Agricultural College, at Guelph, reports that the Joint Worm was abundant and destructive at Guelph. Mr. D. C. Dewhurst also reported it from Cottam in Essex county, and Mr. R. J. Doake from Millbrook, Durham county. Notwithstanding these local occurrences there were few references to Joint Worms in correspondence. In Prince Edward Island the loss from Joint Worms seems to have been more severe. Through the kindness of the Rev. Father Burke I learnt of the occurrence and obtained particulars. The Joint Worm was frequently found in the same fields with the Hessian Fly and the Wheat Midge. The two last, however, were in much smaller numbers than the first.

‘Aug. 22, Bayview, P.E.I.—Find inclosed sections of wheat straw with diseased joints. There is considerable damage to wheat in this locality. The disease is always in the top joint. If this increases here, I fear very much for our wheat crop another year.’—WALTER SIMPSON.

‘Sep. 17, Darnley, P.E.I.—Herewith I send samples of injured wheat straw. What is the cause of the swollen and bent stem? Many fields are affected with these distorted joints and short straw. Some fields are half gone.’—WILLIAM BASSETT.

‘Aug. 22, Park Corners, P.E.I.—I send sample of my wheat. The whole crop was destroyed by some kind of vermin which has also destroyed all wheat about here.’—ALEX. CAMPBELL.

‘Nov. 17, Kensington, P.E.I.—I learn by inquiry that the Joint Worm has been troublesome in lots 18 and 19 in Prince county, and on lot 20 in Queen’s. There are also a few other places. Where the crop was light, the damage was almost complete. In strong growing grain there was only slight loss.’—JOHN ANDERSON.

‘Aug. 14, Malpeque, P.E.I.—I send you samples of wheat which have been affected while growing, by two different enemies. You will notice that some stalks have a swollen joint just below the head, which has turned it at about a right angle to the stalk. I have opened some of these and find small maggots. Another trouble seems to be that the stalk is eaten almost off very near to the base, so that it dies. These two troubles are causing great damage in this vicinity. Some of our wheat fields in this vicinity, especially in Long River and French River, are much injured, so that some farmers are cutting down their grain for feed.’—REV. E. J. RATTEE.

Upon examining these samples, it was found that they were badly attacked by the Joint Worm and also by the Hessian Fly. There were also a few specimens of the red larvæ of the Wheat Midge clustered round the kernels of the wheat in the ear.

Mr. Rattee was informed what the insects were, and it was suggested that the stubble should be ploughed down deeply directly the crop was cut. In his reply, he points out that there would be difficulty in getting farmers to do this because of the prevailing practice of seeding down with a wheat crop, for hay the following year. This, of course, would be a difficulty everywhere; but, as the Joint Worm distorts the stems so that a large number of the hardened joints occur so close to the ground that they are left on the fields with the stubble, it will be found a paying practice even to plough down these new meadows after a single year’s growth, rather than to leave them

for hay while there is any risk of allowing the Joint Worm to increase. Moreover, if a few pounds of clover seed are mixed with the grass seed at the time of sowing, the growth of clover will much more than pay for the seed used by the extra fertility thus added to the soil. Mr. Rattee states that the areas specially infested in his district were the western portion of Queen's county and the eastern part of Prince county.

The standard remedies for Joint Worms are deep ploughing or the burning over of stubble before the insects emerge in spring, the destruction of straw and screenings, and a short rotation of crops, with high farming to keep up the fertility of the soil. Prof. F. M. Webster, who has made a special study of the insect enemies of small grains, writes on this subject in Circular No. 66, U. S. Bureau of Entomology, as follows: 'There are no known remedies for Joint Worms; but, there are several preventive measures that are not impracticable and are reasonably efficient. The Joint Worm Convention which was held many years ago at Warrenton in Virginia, recommended officially that a better system of farming be adopted, with the use of guano and other fertilizers, to promote a rapid growth and early ripening of the grain, and also the burning of stubble, all of which are as advisable to-day as they were at that time. The most serious ravages are observed on thin or impoverished soils, especially along the margins of the fields infested. Anything, then, that tends to add vigour to the young growing grain, will constitute a preventive measure. Burning the stubble where this is practicable, is, of course, most efficacious; but, over the larger portion of the territory ravaged by this pest, it is customary to seed for grass after wheat, and under this condition burning over the stubble fields is impossible. Such fields should be raked over with an ordinary hay rake and the loosened stubble removed and burned before the adults emerge in spring.'

If the straw can be cut low enough to carry the larva-bearing joints from the field with the crop, the using up of this straw before spring would dispose of the insects in a satisfactory manner. It must not be forgotten that at threshing time many of the broken off hardened pieces of straw become separated and are carried through with the grain or with the rubbish. These, therefore, must be attended to in some way which will destroy the larvæ or prevent them from hatching in the spring. All screenings are far better for feed when crushed, and the larvæ in the refuse might be destroyed by placing this in a cattle yard, where it would be trodden into the sodden earth, or into a fresh manure pile, where the insects would be destroyed by the heat of fermentation or by being saturated with the ammoniacal liquids.

THE WHEAT MIDGE (*Diplosis tritici*, Kirby).—In my last year's report I referred to an outbreak of this old enemy of the wheat grower, in the Chilliwack valley of British Columbia. As it was thought possible that the injury might recur this year, a full account of the life history was then given, with a list of the best remedies. During the past summer the Wheat Midge again appeared and was the cause of much loss. Mr. Thomas A. Sharpe, the Superintendent of the Experimental Farm for British Columbia, reports as follows:—

'Agassiz, July 19.—Our spring wheat is badly infested with weevil (= Wheat Midge). Last year it took a large share of Chilliwack spring wheat and some late patches on this side. This year it is taking every one's crop so far as I can hear.'

In 1904 the British Columbia outbreak was the only one reported; but during the season of 1905 I have received reports that the Wheat Midge has been detected at one or two localities in Ontario and in Prince Edward Island. Undoubted specimens were received from the Rev. E. J. Rattee, of Malpeque, P.E.I., and Dr. Charles E. Saunders handed me a specimen found at Ottawa in wheat grown on the Experimental Farm. He further tells me that he found a few of the larvæ last year, when examining hybrid wheats produced in the experimental plots. He also gave me grains of wheat showing the characteristic injury of this insect. In the Ontario Crop Report for August last it is stated that, although all correspondents are silent as to the presence of Hessian Fly, three or four mention injury from either Midge or Joint Worm.

SESSIONAL PAPER No. 16

As this minute insect is capable of causing enormous losses in the wheat crop, should it increase in numbers, it seems well to repeat the remedies which have given the best results.

Remedies.—The remedies for the Wheat Midge depend largely upon the way it passes the winter. The methods which have given the best results are as follows:—

(1) Deep ploughing directly the crop is carried, so as to bury the larvæ so deep that the flies cannot work their way out through the soil.

(2) The burning of all chaff, dust or rubbish known as ‘screenings’ or ‘tailings’ from beneath the threshing machines, as these contain many of the larvæ which are carried with the crop. If fed to chickens or domestic animals, this should be done in a place where none of the puparia can escape destruction.

(3) Clean farming, including the cutting of all grasses along the edges of fields and the ploughing down of all volunteer crops found in wheat fields before winter sets in, so as to destroy an autumn brood where one exists.

(4) The cultivation of such varieties of wheat as experience has shown are least affected by this insect.

CUTWORMS IN GRAIN.—There have been rather extensive injuries by cutworms in grain fields in some parts of Manitoba and the North-west Territories during 1905. The worst of these were in the Edmonton district and other points in Northern Alberta, and in Northern Manitoba. Very few specimens were sent with these complaints of injury, farmers for the most part failing to see the importance of forwarding samples of what they consider such a well known pest. This, however, is far from being the case, and it would help most materially in many instances toward getting prompt and useful advice if specimens were sent. There are a great many kinds of cutworms, all of which vary somewhat in their habits. The points of value to a specialist when advising farmers how to avoid loss, are the exact identity of the species at work, because the habits, the ordinary food plant, usual time of attaining full growth, when power to do injury to crop ceases, and many other points which bear on the choice of the most practical remedy to be recommended, are already known for many species of cutworms. A glance at specimens of the insects is of far more use than the longest descriptions of the cutworms by those who are not used to describing insects. From such specimens as were sent, it is evident that the greater part of the loss in many different kinds of crops was due to the Red-backed Cutworm (*Paragrotis ochrogaster*, Gn.). This is a very wide-spread species, occurring from Nova Scotia to British Columbia. The caterpillar, when full grown, is nearly two inches long; it is very voracious, and will attack almost all succulent vegetation. It is the species which has been the cause of by far the greater part of the loss in grain fields of the West during recent years.

The following letters, chosen from many received, indicate the nature of the infestation:—

‘June 10, Regina.—Cutworms, mostly *P. ochrogaster*, are making havoc in wheat and oat crops up the Edmonton line.’—T. N. WILLING.

‘June 12, Edmonton.—I send specimens of worms that have been destroying the grain about a month. They seem to be most destructive on summer-fallow, although they are now working on spring ploughing and new breaking. They have completely destroyed about ten acres of oats and barley for me, and partly destroyed some wheat. They have destroyed grain over a large part of this country, some having lost from one-third to one-half of their crop. They are now crawling over the ground by the thousand and are working on grain that is ten inches high.’—JOHN N. KERR.

‘June 12, Winnipeg, Man.—I have just returned from a week’s farmers’ insitute work in the Swan River and Dauphin districts in Northern Manitoba. At Dauphin a number of the farmers were complaining that considerable damage had been done

5-6 EDWARD VII., A. 1906

to the crops by cutworms. One farmer, Alex. Birrs, of Dauphin, had had about ten acres of his oat field entirely cleaned out by this pest.'—GEO. BATHO.

'June 20, Dauphin, Man.—I have sent by this mail a pill-box containing about ten cutworms gathered from my barley field, together with a few of the stems cut off by them, including a sunflower stem, which was not cut through entirely, but so nearly so that the plant had fallen to the ground. When I last wrote, the cutworms were working in my neighbour's wheat; but on Friday last they appeared in my barley, although half a mile intervenes, which is sown to wheat. These pests are very prevalent in the Dauphin district. I had an idea that their spreading arose from allowing fallows to grow up in weeds. Their appearance in my barley confirms this idea, as my barley field was not ploughed until spring. A part which was fall-ploughed is free of cutworms. I will be glad of your opinion of this matter.'—THOMAS C. ROBSON.

'November 21, Winnipeg, Man.—Cutworms have been noticeable in some districts during the past season. Reports in a few cases indicated that crops of oats and wheat had to be ploughed up; but the extent of the damage from this pest could not be considered in general to be alarming. It is sufficient, however, to show that in future this insect will have to be considered by the agriculturists of Manitoba, and perhaps, in some districts, a system of cultivation, adopted that will tend to retard its reproduction.'—W. J. BLACK.

The poisoned bran remedy for cutworms is so remarkably effective that I cannot understand how it is farmers who suffer year after year from these enemies, do not remember about it and save their crops. On the whole, I know of no remedy for any injurious insect which has given better results. I can only suppose that the reason why it is not more used, is that, owing to the large size of grain fields, added to the fact that the cutworms do their injury at night, farmers do not at first notice them and then give up in despair, thinking that nothing can be done. A noticeable feature in nearly all the letters received was that these outbreaks occurred on land where vegetation had been left standing the autumn before, either in stubble fields or upon so-called summer-fallows which had been allowed to grow up to weeds late in autumn, because it was thought that, as the weeds could not ripen seeds after the last harrowing, they could do no harm. The presence of vegetation on land in autumn, however, attracts the female moths which lay the eggs from which cutworms are produced. Therefore, all summer-fallows should be kept thoroughly clean right up to cold weather in autumn. Another noticeable fact with regard to the habits of the Red-backed Cutworm is its tendency, when occurring in large numbers, to take the habit of the true Army Worm and march from field to field in search of food. This enables farmers who are alert to head off their advance by placing poisoned bait in their way, which they will eat as soon as they reach it and will be killed in large numbers. If bran cannot be conveniently obtained, any kind of coarse vegetation may be used,—lamb's-quarters, grass, or weeds tied in loose bundles—taking as much as can be grasped in the hand at one time for each bundle, and then dipping these into water containing about an ounce of Paris green to 5 gallons of water. These bundles should be placed about six or eight feet apart, in advance of the army of caterpillars. If bran can be obtained, the mixture should be made dry enough to be broadcasted lightly through the grain or in such places where the cutworms are most abundant. The food habits of the Red-backed Cutworm are remarkable and differ in this respect from almost any other insect known to me. Sometimes a horde of these caterpillars will attack by preference some particular kind of plant and leave other things untouched. They have been found to occur in weedy wheat fields and confine their attention entirely to the lamb's-quarters and other weeds. In other places they will attack oats and leave everything else untouched, and, even when an oat field joins a wheat field, they will stop when they reach the wheat and wander on long distances in search of other food. At other places it will be the wheat that is destroyed and oats will escape. From the above, it is plain that some little observation and thought will be of advantage when an attack is noticed, and it may even

SESSIONAL PAPER No. 16

be found wise on special occasions to leave a horde of cutworms alone all the time they are confining themselves to weeds, but to watch them carefully and have everything ready to apply the poisoned baits, should they change their taste and turn to the farmer's crops. What I wish to point out to farmers now, is that in outbreaks of cutworms, both in gardens and also in field crops, the poisoned bran is a practical remedy which they will do well to try, over a small space, at any rate, whether they believe in its efficacy or not. I have occasionally met people at farmers' institute meetings who jeered at this remedy and declared that it was of no use. In every instance, however, I have found, upon pressing the matter, that it had never been tried by those who condemned it. In field practice, then, it is plain we have two good remedies for cutworms, first the keeping down of all weeds in the autumn, so that the egg laying female moths may not be attracted to the fields, and the poisoned bran or poisoned bait in spring, when the cutworms are found at work.

GRASSHOPPERS OR LOCUSTS.—The same satisfactory report which was made last year with regard to the injurious occurrence of locusts in Manitoba can be repeated for 1905. The only injuries by these insects which were brought to my notice in 1905, were in Manitoba, and were of a trifling nature. This was probably largely due to the nature of the season in those districts, where in the past they have done so much harm. Mr. W. J. Black, the Deputy Minister of Agriculture for Manitoba, writing on this subject, says: 'That celebrated Manitoba intruder, the grasshopper, was not in evidence during the past year to the same extent as previously. A few farmers in the municipality of South Cypress found it necessary to use Paris green to destroy the insects during the early summer; but, owing no doubt to an abundant rainfall in the season when crops were growing, no serious damage has resulted.

Mr. Norman Criddle, of Aweme, Man., says:—'Locusts are no longer troublesome here. In the Stockton district a strip of wheat on light soil was noticed which had been eaten into for about fifteen feet. This was the only place that I have heard of where any damage was done, and, so far as I could see, no effort had been made to stop their depredations.

THE PEA MOTH (*Semasia nigricana*, Steph.).—The caterpillars of the Pea Moth were abundant in Nova Scotia and New Brunswick, and also in some parts of Quebec province and in northern Ontario. In the past there is no doubt that injury by this insect has been confused with that of the Pea Weevil. This is largely due to the foolish and widespread use of the word 'bug,' for every kind of insect; but in this case I find that it has been the cause of the useless expense and trouble in treating a large number of seed peas for an insect which was nowhere near the seed but was passing the winter safely in the fields where it had destroyed a crop the previous year. The Pea Moth has come much more into prominence during the past two seasons, owing to the almost total absence from our Canadian pea fields of the Pea Weevil (*Bruchus pisorum*, L.). The presence of the Pea Moth in Canada as an enemy of cultivated crops may be said to be a regular occurrence in all the eastern provinces, from the Atlantic seaboard as far as the eastern counties of Ontario. In the province of Ontario, although sometimes widespread and serious outbreaks occur, they are of a very intermittent nature and for many years no injury can be detected in cultivated peas. There is, however, in wild leguminous plants a native insect with a very similar caterpillar, which is widely distributed through most parts of Canada. Although the work of this insect has been detected many times, up to the present the moths have not been reared.

Owing to the importance of the injury by the Pea Moth, I have, when occasion arose, tried experiments to see whether spraying the peas immediately after the pods were formed with a poisoned soap mixture might not be effective in the same way that a similar treatment is for the Codling Moth. The insect occurs so seldom at Ottawa that it is difficult to arrange experiments. Some years ago Mr. J. E. Wetmore,

5-6 EDWARD VII., A. 1906

of Clifton, N.B., kindly carried out for me some experiments which seemed to indicate that this might be a useful remedy; but I regret to say that some careful investigations recently made by Mr. Saxby Blair, at the Experimental Farm at Nappan, Nova Scotia, have not confirmed these good results. The exact history of our American Pea Moth has never yet been traced; but it is to be presumed that the eggs are laid on the young pods as soon as these are formed, and that the caterpillars eat their way into them and attack the forming seeds. It was hoped that, by distributing a thin film of poison over the plants and pods, the young caterpillars would be poisoned when eating their way in. On account of the waxy covering on the surface of all parts of the pea plant, whale-oil soap was added to the poison mixture to make it adhere. For early peas the application was Paris green $\frac{1}{4}$ lb., whale-oil soap 1 lb., water 40 gallons. The plots were sprayed just after the pods were formed, and one application only was made. The early varieties of peas used were the Alaska, Gradus and American Wonder. The pods were gathered about 10 days after the spraying, and, when the treated and untreated lots of 500 pods each were examined, it was found that there was practically no difference in the amount of infestation, which ranged from 3 to 11 per cent. For late peas, the amount of Paris green was doubled for a second application, that is, these peas received two sprayings, the first on July 20, with the $\frac{1}{4}$ lb. mixture of Paris green, and the second on July 29, with half a pound. The pods were not gathered until August 17, and the results were no better than in the other experiments. Where the poison was used, 22 per cent of the pods were wormy; and where none was used, there were a few more, i.e., 27 per cent. It is possible that a knowledge of the full life history of this insect may give a suggestion as to a practical remedy, and efforts will be made to obtain these data as soon as possible.

The remedies which have given the best results, are the planting of peas as early as possible and sowing the earliest ripening varieties. For table use any variety which can be grown ready for the table by the first week in July, will be free from attack. As this insect passes the winter as a caterpillar inside a silken cocoon spun in the ground beneath the plant upon the seeds of which it had fed, it is of course advisable to adopt the common sense practise to use land for the new crop as far as possible removed from fields which have been used previously for the cultivation of seed pease. As soon as the crop is picked, all pea vines should at once be burnt so as to destroy small and imperfect pods which frequently contain the larvæ of the moth.

The perfect insect which lays the eggs from which the 'pea worms' hatch is a small gray moth three-eighths of an inch in length when the wings are closed, which is able to fly a considerable distance. A correspondent was good enough to give me the following information which may be of use in working out the complete life history of this insect. Mr. W. E. Taylor, writing from Beaverton, Ont., on Nov. 25, says:

'I wish to ask you about the statement in Bulletin 52, where you recommend to sow pease as far as possible from the previous year's pea field. I sowed my pease this year more than a mile from any other pea field and pease have not been grown near here for three years. The crop was wormy. We have no 'Bug' or true Pea Weevil here, so they were the caterpillars of the Pea moth. The seed was sown about May 20, and it was an early kind, the June or Dan O'Rourke. How did the pest get here? Do the moths lay eggs on the dry pease and gum them over?'

In the above instance the moths must have flown from a distance to lay their eggs. These, as stated above, are laid outside the pea pods, while these latter are green and soft.

FODDER CROPS.

Fodder crops were, on the whole, very satisfactory. Large crops of hay were secured in the west, and the prairies provided good pasture all through the summer. Brome-grass and Western Rye grass are being more grown every year. 'Pastures (in

SESSIONAL PAPER No. 16

Ontario) were in from fair to good condition during the summer and fall, and this favoured all classes of live stock. Cold, wet weather at time of planting gave corn a set back; but midsummer conditions were so favourable that corn picked up in a wonderful way. Most returns show an average yield.'—C. C. JAMES, *Nov. Crop Bull.*

The same conditions and results as prevailed in Ontario, were also found in Quebec and parts of New Brunswick. For the last named province, generally speaking, the crop of hay was good; some counties cut more than ever before, but a cold, wet spring followed by a long drought was severely felt in some places. The returns from Nova Scotia in all but two or three counties show fodder crops were well above the average. 'We have had a better season for the growth of crops than for several years, that is, if we except apples.' (B. W. Chipman.) In Prince Edward Island 'Hay crops were almost up to the average. Clover and timothy were somewhat light owing to the drought of last year. Hay was saved in good condition. In very few places is corn reported below the average.' (J. C. Readey.) There was no serious loss in fodder crops from insects. Cutworms, as is the case every year, were troublesome in some places early in the season, but the season allowed of gaps being filled by resowing. Near Montreal the Corn Root Maggot was reported in corn fields where germination of the seed had been delayed by cool, dry weather. Clover, although very much attacked by the Clover-seed Midge in Ontario, gave very heavy crops of hay in all the eastern provinces of the Dominion. The Clover Leaf Weevil and the Green Clover Weevil were reported from the Ottawa district, the former for the first time, and the Red-headed Flea-beetle (*Systema frontalis*, Fab.) from Ottawa and Guelph; but no appreciable injury was wrought. Clover Dodder was frequently inquired about from the abundance of the seed in clover seed sold. In one instance a crop of alfalfa at St. Mary's, Ont., was much injured.

THE ROSE CHAFER (*Macrodactylus subspinosus*, Fab.).—This well known enemy of the fruit grower and flower gardener has this year appeared in a new role. Towards the end of June last the Steele, Briggs Seed Co., of Toronto, sent me several specimens of the Rose Chafer beetles, with the surprising statement that they had been taken from a 20-acre field of fodder corn, growing near Priceville, Ont., which they had been attacking for two days. The corn at the time was about eight inches high, and growing very thriftily. There was no appearance whatever of any trouble four days before the letter was written; but the beetles appeared in vast numbers on June 26, and covered about two-thirds of the field, averaging about twenty insects to a plant, and began to devour the leaves. Naturally a remedy was asked for as soon as possible, as it was claimed that no one there knew the insect or had ever seen anything like it before on corn. It was suggested to the owners, Messrs. S. Price & Sons, of Toronto, to spray the fields at once with a whale-oil soap solution of one pound of soap in five gallons of water, this application having been found very effective against the Rose Chafer by Prof. Webster, in Indiana, the spray killing every beetle it fell upon. It was also suggested to dust the crop with a mixture of one pound of Paris green in 20 pounds of freshly slaked lime. Fortunately, the visitation was of very short duration, and the crop subsequently outgrew all traces of the injury. Messrs. Price & Sons wrote with regard to this outbreak on July 19, as follows: 'We are glad to say that the Rose Chafers which were injuring our corn field a few weeks ago, have all gone. They all went inside of 24 hours after we had written to you. They stayed with us for three days and did considerable injury; but the corn now seems to have outgrown it, and to be all right. They all flew away before we had a chance to spray them.'

ROOTS AND VEGETABLES.

Root crops in most parts of the Dominion gave heavy returns. Potatoes in Ontario and in parts of Manitoba were materially reduced by the Potato Rot. Turnips were,

generally speaking, poor and far less satisfactory than mangels. The Turnip Aphis was reported as in greater numbers in western Ontario than for many years. In the eastern counties of the province the reverse of this was the case. Cutworms did some harm and the Turnip Flea-beetle was stated to be very destructive in Pictou county, N.S. The Colorado Potato Beetle was less destructive than usual in the Maritime Provinces, but was mentioned as unusually abundant in Manitoba. Mr. W. J. Black, of Winnipeg, writes:—‘The Potato Beetle has this year been much more in evidence than ever before; and, in many cases, those who have not been previously familiar with this insect and its method of destroying the potato plant, have had their crops literally consumed before they were aware of what was taking place. The greatest damage from this pest has been in the Red River valley; but it would appear that it is gradually working its way westward. It was noticeable as far west as Portage la Prairie; but at Brandon it has not yet become destructive. Cutworms, chiefly the Red-backed Cutworm, did much injury at several places, in gardens as well as in fields. Where attended to promptly with the poisoned bran remedy satisfactory results were invariably secured. Two new pests of cultivated plants were reported from Manitoba by Mr. Norman Criddle. The Knot-weed Beetle (*Gastroidea polygoni*, L.) did considerable harm to rhubarb by eating holes in the leaves, and *Galeruca externa*, Say, a chrysomelid which feeds naturally on *Lepidium apetalum*, an indigenous member of the cress family, turned its attention to cabbages and turnips.

THE STALK BORER (*Papaipema nitela*, Gn.).—In the past all references to injury by stalk borers in potatoes, corn and other crops in Canada have been for the most part attributed to the caterpillars of the Stalk Borer (*Papaipema nitela*, Gn.), sometimes referred to as the Potato Stalk Borer. At Ottawa many years ago I found that nearly all injuries by stalk borers to plants in vegetable and flower gardens were by the Burdock Borer (*Papaipema cataphracta*, Grt.), and I could find no specimens of *P. nitela* in collections, which had been reared from cultivated plants in Canada. During the past summer, however, *P. nitela* was very abundant and destructive in the western counties of Ontario and in the State of Michigan. Through the kindness of Professor Lochhead, I learnt of localities where I could obtain specimens for study. Mr. G. W. Riseborough, of Fargo, Ont., helped me very much in this investigation and kindly sent me several consignments of the caterpillars and the plants they were attacking, as well as some parasites which he had found with the larvæ. Although, on the whole, this abundant occurrence of the Stalk Borer in Ontario had little effect on the crops attacked, it was very interesting and worthy of record.

‘Fargo, Ont., July 3.—I was examining to-day some of my corn fields and find that the borer has left them very thin in some places. The injury is more noticeable in corn than in other plants, because the top fades quickly. I have found several other fields besides my own affected by this insect. The good corn weather which we have had recently, has pushed the plants on so fast that the effects of the borer are not nearly so apparent now as they were, and, apart from one or two pieces, the damage does not seem to be very great. Many other plants were affected in this neighbourhood besides the corn. I have found the caterpillars in potatoes, tomatoes, Canada Thistle, elder, lamb’s-quarters, garden beans, ragweed and a few kinds of garden flowers.’

‘July 7.—I was looking at 30 large tomato plants to-day which are just beginning to blossom, and I find 8 of them with borers in them.’

‘July 13.—I found a worm yesterday just beginning to bore into a pigweed stem. When discovered, only his head was buried. In fifteen minutes he had buried in his whole length. I was surprised, too, to find a plant of sweet clover which as you know has a very tough stem, with three holes in it and two worms. They cleaned out the centre of the stem for about two feet. The early potatoes, tomatoes and most flowers and weeds do not show the effect of the borers so quickly as the corn does, because they do not fade so easily. The corn in this section never grew more quickly than during

SESSIONAL PAPER No. 16

the last two weeks. The effects of the worm are not so noticeable as they were a little while ago.'—G. W. RISEBOROUGH.

'Mount Brydges, Ont., June 30.—I send you specimens of a grub which is playing havoc with the potato and the tomato crop. They bore into the stalk and eat the heart out. I have taken dozens of them out of potato and tomato plants and of course the plant is done when the trouble is noticed.'—W. B. DUNN.

It is very seldom that a remedy is required for stalk borers in Canada. The number of specimens which occur in any one locality is, as a rule, small, and no remedies need to be applied. Whenever an injured plant is noticed, the borer should be sought for and destroyed; but I know of no treatment by which their outbreaks could be prevented. The presence of the larvæ in many kinds of weeds points to the advantage of keeping down all such useless and unnecessary vegetation.

THE CORN WORM (*Heliothis obscura*, Fab., = *H. armiger*, Hbn.).—This insect which always occurs in Canada in an irregular manner did no harm in the eastern provinces and in Ontario, but for the first time was complained of from Manitoba. The species was known to occur in the prairie provinces from moths which had been collected, but up to the present so little sweet corn has been grown for table use that no one had noticed its injury before this year. The first mention came to me through the *Nor-west Farmer*, early in September. The samples sent were grown by Mr. Neil Bayne, at Pipestone, Man., who sent several ears injured in the ordinary way, and also some of the caterpillars at work in them. Both the green and the brown colour varieties were represented. The brown were stated to have been much more abundant in the early ears of corn, to which they had done a great deal of damage. The attack came to an end about September 20.

Under date September 11, Mr. W. C. Hall, wrote from Headingly, Man.:—'I send an ear of sweet corn (Cory) and shall be obliged if you can let me know what grub this is, which is infesting a great part of the corn this year for the first time. Many ears are destroyed, the injury begins at the top.'

The most westerly occurrence was at Fairy Hill, Sask., from which place Mr. Robert Mollard writes: 'Sept. 4.—Inclosed you will find a cob of corn eaten by a grub, which is also in its place in the cob. This is the first year I ever saw corn affected in this way, and most of the cobs are similarly affected.'

It is only recently that the farmers on our prairies have discovered that they can grow excellent sweet corn for table use, and it will be most unfortunate if this troublesome pest should develop in such numbers as to induce growers to give up the culture of such a popular and wholesome vegetable.

The remedies which have been recommended, are the hand-picking and destruction of the caterpillars as soon as their presence is detected by the premature discoloration of the silk. It is also claimed that many moths may be taken at night in lantern traps consisting of a lighted lantern placed in an open pan containing water with a little coal oil on the top of it. When a crop is known to have been attacked by the Corn Worm, the old stems should be removed from the field as soon as the crop is gathered, and the land ploughed deeply in autumn so as to break up the cocoons and expose the pupæ to the weather and their various enemies among the small birds and mammals.

THE VARIEGATED CUTWORM (*Peridroma saucia*, Hbn.).—In 1900 this large and late occurring species of cutworm did a great deal of harm to all kinds of vegetation on the Pacific coast, extending from Northern British Columbia as far south as Oregon. Very little injury has been recorded against it since that time; but during the past summer the caterpillars were found in noticeable numbers at several places in British Columbia, reports having been received from Mr. J. W. Cockle, of Kaslo, Mr. W. A. Dashwood-Jones, of New Westminster, Mr. R. V. Harvey, of Vancouver, and from Mr. J. R. Anderson, the Deputy Minister of Agriculture of British Columbia, who writes under date July 26:—'I regret to say that *Peridroma saucia* is again bad this year,

5-6 EDWARD VII., A. 1906

not as numerous as in 1900, nor, as far as I can make out, so widely distributed. It is sufficiently bad, however, to induce me to send out the emergency bulletin, of which I send you a copy. It is remarkable how soon people forget what has been told them, and I have constant applications for information as to the best remedy. I am again recommending the Paris green and bran which did such excellent work in the last outbreak.'

Mr. T. N. Willing, of Regina, N.W.T., in reporting on the injurious insects of the year, states that the larvæ of this moth were very abundant during August at Regina, and he sent several of the moths, which he had reared from caterpillars in gardens at Regina.

The comparative abundance of the species in British Columbia should be turned to advantage by gardeners in that province to prepare themselves before next season with materials for poisoning the caterpillars, should they appear again in numbers next summer. If this is done there should be no great loss.

THE TURNIP AND CABBAGE APHIS (*Aphis brassicæ*, L.).—Reports relating to the Turnip Aphis from our own correspondents during the past summer were very few; but it is stated by Prof. James in his November Crop Bulletin as follows:—'The aphis popularly known as the turnip louse appeared in greater force (in Ontario) than for years and hindered the development of the bulbs, which several correspondents describe as being rather small and rooty. The cabbage worm or an insect resembling it also attacks the plant in different parts of the province. Favourable reports regarding the crop were rare.'

'Manilla, Ont., Dec. 1.—I started on an institute trip at Shelburne, Grey county, Ont., and came south and east. We heard great complaints about the Turnip Aphis destroying the turnip crop west of Toronto, but not much damage appeared to have been done east of that city. The early sown fields suffered most, and, so far as I could learn, those fields that were sown after June 20 appeared to be almost free from aphis. I have made it a point to sow my turnips for many years past from June 20 to 22, and we have never had any serious trouble with the aphis. Sometimes we could find a few plants in a place with some on, but not enough to injure even those to any great extent.'—HY. GLENDINNING.

There were also restricted but very serious outbreaks in some parts of British Columbia.

'St. Mary's Creek, Gang Ranch, B.C., June 12.—Kindly give me a cure for the lice that settle on cabbages and turnips, completely destroying them. They accumulate by millions. Last season was our first experience. They completely destroyed our whole cabbage plot. I have been in this country 47 years but I never saw them before.'—W. W. WYCORR.

'Monte Creek, B.C., Aug. 16.—I send you a few leaves of Swede turnips covered with a pest which has spread terribly quickly and is now going from the turnips to the cabbages. Last year we had some of these, but they were not nearly as bad. It would seem as if the very hot weather and scarcity of water for irrigating is favourable to their increase.'—HEWITT BOSTOCK.

'Cash Creek, B.C., Sept. 23.—I send specimens of a pest which destroyed my turnip crop last year and threatens them again this. Kindly give me the name and some remedy if you know one. If there is none, we must give up trying to grow turnips.'—C. A. SEMLIN.

Reports of injury by this insect to rape came from Mr. George Wright, of Elora, Ont., and from Ottawa. Dr. Hamilton, of Mahone Bay, N.S., writes of its injuries in his locality as follows:—

'The turnip aphis was abnormally abundant this year, specially on cabbage. I heard of patches in which nearly every plant was affected. We have these insects in some numbers every year, but it is only at intervals and in special localities that the damage is very severe. Perhaps to this is due the fact that hardly anybody here seems

SESSIONAL PAPER No. 16

to know of or apply the proper aphid-destroying mixtures which answer well for this as for other species.'

The Turnip Aphid and Cabbage Aphid are the same species. It was probably imported from Europe many years ago and is now a pest right across the continent. In British Columbia it is as a rule much more destructive to early cabbages and cauliflower in gardens than is the case in the East, where its chief depredations are in turnip fields.

The remedies which have given the best results are the prompt spraying of the first colonies of the season as soon as they appear, with kerosene emulsion or whale-oil soap solution. Of great importance as a means of destroying large numbers of the eggs or of the plant-lice which may possibly winter over as such in Canada (they certainly do so in some parts in the egg condition) is the ploughing down deeply, the feeding off, or the removal from the fields of all leaves of turnips and cabbages as well as remnants of those crops.

THE RED TURNIP BEETLE (*Entomoscelis adonidis*, Fab.).—The usual accounts of slight injury to cabbages and turnips have come in from points in the North-west Territories and Manitoba. Mr. Norman Criddle reports the beetles as rather common at Aweme, Man., on radishes in gardens and on a native food plant, *Erysimum parviflorum*, on the open prairie. For the first time, however, injury by these insects has been reported from British Columbia, from Mr. H. E. Church, of Hanceville, and Mr. C. H. Norris, of Hazelton. The latter writes that it had given great trouble attacking turnips, cabbages, &c., and was worst on young turnips of which it stripped the leaves clean, leaving only the ribs. Specimens were even sent from Dawson, Yukon Territory, by Mr. W. J. Reynolds, who said that they had destroyed cabbages entirely, eating them right down to the stump, and were at the time of writing, July 26, eating the turnips to rags.

Any of the ordinary arsenical poisons for leaf-eating beetles have proved effective against the Red Turnip Beetle. It has been found that dry mixtures are more convenient for use on cabbages and smooth-leaved turnips, owing to their waxy covering. Should it be more convenient to use liquid mixtures, these can be made to remain on the surface of the leaves by adding about a pound of soap to every ten or fifteen gallons of wash.

THE CARROT RUST-FLY (*Psila rosæ*, Fab.).—It is some years since we have had a severe attack of Carrot Rust-fly as far east as Ottawa; but early last summer several occurrences were brought to my notice around Ottawa. Some of these were only slight attacks, but in other cases whole crops were destroyed. Strange to say, although so severe in early carrots, there was no appearance of injury when the roots were dug in the autumn. In Nova Scotia and New Brunswick this is a much more troublesome pest of the market gardener than it is further to the west; but even there it is intermittent in its attacks. Dr. C. A. Hamilton writes that in 1902 and 1903 one-half to three-quarters of his carrots at Mahone Bay, N.S., were destroyed by it. In 1904 and 1905 he did not see a single damaged root, although the carrots were sown in the same garden. Notwithstanding this immunity in his garden in 1904, several of his neighbours suffered severely. During 1905 there was practically no injury.

The treatment which has given good results in preventing injury by the Carrot Rust-fly, is to sow as late as possible and when thinning out carrots, to do this late in the day and then spray the rows at once with a deterrent wash such as kerosene emulsion or a carbolic wash. The time when most injury is done is in June and July, so that two or three sprayings, a week apart, will generally protect the crop from injury in ordinary years. Should maggots be found in stored carrots, the sand in which these roots have been kept for the winter should in spring be treated in some way that will insure the destruction of the puparia or will at any rate prevent the emergence of the flies. This may be done either by burying it in a deep hole or by throwing it into a pond or into a barnyard, where it will be thoroughly trampled by stock.

5-6 EDWARD VII., A. 1906

THE DIAMOND-BACK MOTH (*Plutella maculipennis*, Curtis).—The small active caterpillars of this moth were abundant and destructive in many places during 1905. They did considerable harm in rape fields and on Swede turnips and cabbages, and occurred at various places from Nova Scotia to British Columbia. I have no record of widespread or very serious damage in the East, but there is every indication that, if the summer had been a hot and dry one, the loss would have been very great. As it was, the frequent and copious rains in those places where the outbreaks occurred, enabled the plants to make such vigorous growth that the attacks of the caterpillars were of small moment. It is well known that moisture and continued damp weather are detrimental to this insect. Dr. C. A. Hamilton found the species very abundant for several miles round Mahone Bay, N.S. It also occurred in Prince Edward Island, at Youghall, near Bathurst, N.B., at Ottawa, and at several places in Manitoba, the North-west Territories and British Columbia.

The remedies for this insect are dusting the plants infested with a dry Paris green mixture consisting of one pound of Paris green in twenty-five of lime or wood ashes, or spraying them with kerosene emulsion or a whale-oil soap solution. To allow of the mixture being thrown well up under the leaves such a convenient implement as has been given to me by Mr. Geo. E. Fisher, of Freeman, Ont., should be used. This consists simply of a short length of metal pipe bent in the middle to the required angle and having the nozzle attached to one end. As a supplementary treatment inducing a vigorous growth, light dressings of some quick acting fertilizer such as nitrate of soda, hoed in round the roots of the plant, are of great advantage.

THE CUCUMBER AND POTATO FLEA-BEETLE (*Epitrix cucumeris*, Harr.).—A serious enemy to potatoes, but one which is frequently overlooked, is the so-called Cucumber Flea-beetle. This minute dusky-black hopping beetle, about one-twelfth of an inch in length, appears early in spring and again about the beginning of August, and sometimes in such numbers that it becomes a serious check to potatoes, tomatoes and all kinds of cucurbits or members of the Gourd family. A remarkable outbreak of this beetle occurred in Nova Scotia last August.

'Mahone Bay, N.S., August 14.—We have the Cucumber Flea-beetle here on potatoes more or less plentifully every year especially in June; this spring, however, I thought they were not as abundant as usual. On August 3 I looked over my potatoes for the Colorado Potato Beetle and do not remember seeing any flea-beetles at all. On August 5 one side of the patch was simply alive with them, and by the next day they had spread over the whole patch. I partly counted and partly calculated the number and found them to average about 800 to each plant. By the 9th they had destroyed between a quarter and a half of the leaf surface of the side of the patch first attacked. That afternoon I gave them a dose of poisoned Bordeaux mixture. On the 11th they had practically disappeared. A neighbour's potatoes about 150 yards away were nearly as badly infested as my own. I have an idea that the poisoned Bordeaux mixture may act rather by driving the beetles to adjacent vegetation than by killing them. After they left the potatoes they turned their attention to cucumbers, beans, pumpkins, squashes and tomatoes which were badly eaten. On account of this troublesome pest it is almost impossible, without the most careful attention, to raise tomatoes here from seed sown in the open, because they sweep away the young plants as soon as they appear above the ground.'—C. A. HAMILTON.

The efficacy of the poisoned Bordeaux mixture for this insect was discovered by Prof. L. R. Jones, of Vermont, in his very thorough experiments with Bordeaux mixture against the Potato Rot. It is probable that the copper sulphate in this composition does have much effect in rendering the foliage distasteful to the beetles; but there is also little doubt that great numbers of the beetles eat the foliage and are poisoned. This useful remedy is suitable for application to all of the plants mentioned above and is also useful upon them in preventing fungous diseases which regularly attack them.

SESSIONAL PAPER No. 16

THE SUGAR BEET WEBWORM (*Loxostege sticticalis*, L.).—In my report for 1903 I referred to an outbreak of the Sugar Beet Webworm in the West and treated it at some length, so that in case of a future outbreak those who are now turning so much attention to the cultivation of the sugar beet in the Cardston district of Alberta, might be prepared. During the past autumn I received an account of a local occurrence in that district. Mr. J. B. Merrill, who is a most progressive farmer and fruit grower at Magrath, Alta., writes on August 25:—‘I send you by this mail specimens of worms which are destroying our beet crops here at an alarming rate. I take them to be the Sugar Beet Webworm of your 1903 report. What had we better do to control them? We are spraying them with Paris green now, but the beets are stripped of their leaves. Do you think that they will survive the attack and be of any use?’

Mr. Merrill was written that he had applied the right remedy and that the plants would certainly revive, but would be injured to the extent that the leaves had been destroyed, and that, although the roots would be reduced in size, they would probably still give a paying crop. That this proved to be the case is shown by a later letter from Mr. Merrill:—

‘Magrath, Alta., Nov. 3.—I have to day delivered the last load of my beets on the cars, so am now in a position to answer your questions. I had a very good stand of beets on my 17 acres. Towards the end of August, after a three days’ absence, I was surprised to find the plants covered with worms. Part of the field had been irrigated. Here the plants were not as badly affected as where they had no water. These latter were swept clean, but they afterwards started a new growth of leaves, and from this part of the field I harvested only four tons to the acre; but the watered beets yielded 13 tons to the acre. When ploughing up the beets, we found enormous numbers of the worms about two inches under the surface of the soil. These we hope to destroy by winter cultivation. I think that the moths must have come from an adjoining lucerne patch.’

THE SPINED RUSTIC (*Barathra occidentata*, Grt.).—During the month of July a great many different kinds of plants in gardens were attacked at Ottawa by large, smooth, cutworm-like caterpillars, which were at first greenish in colour, having the body divided into two equal areas above and below the spiracles. The upper of these areas, or the back of the caterpillar, was darker by reason of some black patches, and the under side of the body was of a yellowish hue. These rather inconspicuously marked caterpillars were largely nocturnal in habit, coming out at night and feeding singly on nearly all kinds of vegetation, but being particularly destructive to the seed pods of larkspurs and to the foliage of the bleeding-heart (*Dielytra spectabilis*). In the vegetable garden, spinach and cabbages were most attacked. After the last moult, about the middle of July, these caterpillars were much more conspicuously marked, presenting a handsome Mamestra-like appearance, with three lines down the back and with each segment ornamented with large velvety black patches; the head is honey-coloured and mottled. When full grown these caterpillars are very voracious. They are about two inches in length, cylindrical in shape like cutworms and attain a diameter of nearly $\frac{1}{4}$ of an inch. There is great variation in their colours, some specimens appearing to be almost black while others have a dark olive green aspect; but all specimens show a distinct band along the sides below the spiracles, which is clear yellow in colour, marked centrally with red. These caterpillars were the progeny of a noctuid moth which up to the present time has been a very rare species in all collections of insects. It has been identified for me by Dr. J. B. Smith, as *Barathra occidentata*, Grt., an insect which is so rare that the only two specimens I had ever seen were two reared by Mr. Guignard from larvæ which he had found upon larkspurs in his garden in 1898. Mr. C. H. Young, of Ottawa, an energetic collector of moths, also took a single specimen on June 6 of the same year, and another one the following year on

5-6 EDWARD VII., A. 1906

June 19. During last summer, while collecting moths at Ottawa, we found that this species was well represented among captures which we made during the month of June around electric lights; and several more specimens were collected hiding away in dark corners of offices and out-buildings. A few weeks later than this, caterpillars were found in great abundance out of doors on various kinds of plants. These we were able to identify by comparing them with specimens which we had reared from eggs laid by captured females. We were fortunate enough to work out the whole life history of the species. There is only one brood in the year, the eggs being laid in June and July and the caterpillars feeding through July and into August. When full grown they bury a few inches beneath the surface of the ground and change to shining brown chrysalids, from which the moths do not emerge until the following June. The moth is a handsome insect, expanding over an inch and a half when the wings are open. The upper wings are a dark silvery gray, so thickly checkered and marked with waved blackish lines as almost to hide the ground colour; hind wings silvery gray clouded with fuscous on the outer half. Near the end of the upper wings is a waved white line. The outer or kidney-shaped of the two marks which are characteristic of noctuid moths, is margined with black and is boldly marked with white; but the other, the orbicular, is hardly perceptible from the other marks of the wings. On each of the upper wings are three rather large suffused pale, bronzy areas, one close to the base, and the other two towards the upper and lower angles. The upper of these lies beyond the kidney-shaped mark and just inside the waved white line which runs down inside the outer margin. The thorax and abdomen are crested and of the same colour as the general tone of the wings. The genus *Barathra* to which this moth belongs, is easily distinguished from its near relatives by the presence of a long curved claw on the outer side of the tibiae of the front pair of legs.

Not only did this insect occur in abundance at Ottawa, but specimens were sent from Mahone Bay, N.S., where my energetic correspondent, Dr. C. A. Hamilton, makes many very valuable observations for me. Dr. Hamilton found the caterpillars when they were quite small, upon cabbages, turnips, cauliflowers, corn and sweet peas. They were, at the time he first wrote, July 23, quite small, and were of the green colour which characterizes the first stages. Like the larvæ of many other noctuids, while very young, they resemble in shape and manner of moving those of the geometer moths. Dr. Hamilton writes:—'Aug. 11.—I am sending you some more of the caterpillars which I find on my cabbages and cauliflowers. I have also found them on sweet peas and on one small patch of Kohlrabi. I also send a few from corn. I have examined nearly all the patches of these vegetables about this village and from one to six miles out in various directions, and have found them present in all but a few cases. The damage, on the whole, is not very great, the worst perhaps being in a small patch of cabbage in which I counted 14 out of 70 plants, so badly eaten as to be worthless. A few other patches were nearly as badly injured, but most had only from one to five per cent noticeably affected. Turnips were infested to about the same extent. Cauliflowers are not much grown here, but I saw many plants almost ruined. The attacks were confined almost entirely to the cultivated Cruciferae. Fresh batches of young were being hatched from the egg until up to about August 1.'

Moths of this species were taken at Lévis, Que., by the Rev. Dr. Fyles, and I found the caterpillars in great numbers stripping a patch of cabbages in the garden of Mr. W. McKirdy, at Nepigon, Ont., on August 21. These were very much later than at Ottawa, where most of the larvæ had attained full growth two or three weeks sooner.

As a remedy for this insect, almost any of the ordinary applications for leaf-eating insects would answer; but I found them less susceptible than I supposed would be the case, to an application of pyrethrum insect powder. There is, of course, the possibility that the powder may not have been good; but it did not kill the caterpillars as quickly as is the case of most other similar caterpillars upon which I have tried it. The poisoned bran mash answered well at Ottawa.

FRUIT CROPS.

The fruit crops from one cause or another were somewhat irregular, except in British Columbia, where they were well up to the average and of high quality.

In Ontario, although a good crop of apples was marketed, there were districts where they were poor. This was thought to be largely due to the severe winter of 1903-4, followed by the very heavy crop of last year, followed again by the hard winter of 1904-5. Apples in the Ottawa district, where the orchards had been sprayed, were of high quality and abundant. Heavy wind storms in October reduced the yields of first-class fruit to some extent.

The St. Lawrence and Ottawa valleys and the Eastern Townships of Quebec gave good crops of autumn and early winter apples, but very light crops of winter varieties.

Mr. A. McNeill, Chief of the Fruit Division of the Department of Agriculture, in summing up the apple crop for the year says:—'The Dominion, as a whole, will produce about one-third as many apples as last year. The fruit will be freer from scab, but somewhat more injured by Codling Moth. The favourable weather of autumn allowed the numerically small crop of apples on the trees to fill up better than usual; and, although the apples are on the whole rather small, they are clean and of good quality, and probably the final result will give average paying returns to the growers.'

The apple crop in Nova Scotia is reported as being below the average on account of a heavy frost in June, which injured the blossoms; nevertheless, it is estimated that there were probably four hundred thousand barrels for export and the local market, worth at current prices close to one million dollars.

Mr. S. C. Parker, Secretary of the Fruit Growers' Association of Nova Scotia, reports on the crops of the celebrated Annapolis Valley, N.S.—'Apples: crop fair, probably 75 per cent of average, quality varying from good to very poor; fungi quite bad although thorough spraying gave some clean orchards. The pear crop was large, but of rather poor quality. Plums and small fruits gave good crops. A severe frost on June 6 did much injury to blossoms, and perhaps easterly winds and dull weather during the blossoming period did more. Early fall frosts injured the cranberry crop somewhat. A sharp freeze on October 26 ruined many hundred barrels of unpicked apples. Season was very favourable except for one or two frosts.'

Losses from the attacks of injurious insects were less than usual in all parts of the Dominion, owing to the much greater attention which is now being given by fruit-growers to spraying and other advanced methods of orchard management. Peaches in the Niagara district and in British Columbia, where grown, were a heavy crop. Much the same may be said of pears and plums. Plum rot and curculio are mentioned in Northern Ontario reports. The grape crop of Ontario was heavy, and as there were no killing frosts till very late, the fruit ripened well.

Small fruits almost everywhere gave fairly good crops. The insects which were oftenest mentioned as injuring fruit crops were the San José Scale, the Codling Moth, the Apple Woolly Aphis, which has been more abundant than for many years, the Apple Aphis, the Oyster-shell Scale, and the Cherry Slug. The Apple Maggot mentioned in my last report as present at Como, Que., was this year much more prevalent in that locality, and a special effort was made to apprise the fruit growers of the best remedial measures and the danger of neglecting to attend to the matter at once.

Notwithstanding the magnificent crop of fruit gathered in British Columbia, there was considerable injury done by regularly occurring insect pests. The Woolly Apple Aphis and the Green Apple Aphis were very abundant in some places and did noticeable injury. According to Mr. R. M. Palmer, who has excellent opportunities for examining the crops throughout the province, the Eye-spotted Bud-moth has been worse than for many years in the Victoria district. The injury of this caterpillar was also much augmented by a late frost in May. Mr. Thos. Cunningham, the In-

5-6 EDWARD VII., A. 1906

spector of Fruit Pests, reports the Lesser Apple Worm as abundant and destructive at Kamloops and Trail.

THE SAN JOSÉ SCALE (*Aspidiotus perniciosus*, Comstock).—Much has been written recently in newspapers and magazines on the San José Scale injury in Ontario, but there is, as a matter of fact, little change in the condition of our orchards in Ontario since last year. This in itself is not satisfactory, because, where careful commercial growers have attended to their orchards properly, and have used the recommended remedy, good clean crops have been harvested. There are, however, a great many small growers and private individuals who do nothing at all against the scale, and consequently it holds its own. The Federal Government still maintains at considerable expenditure fumigation stations, by which any danger of the introduction of infested stock is prevented. The Provincial Government of Ontario and the leading nursery-men are making every effort to avoid the distribution of infested nursery stock, and, if a greater effort were put forth by all concerned, this dire enemy of the fruit grower could certainly be reduced very much in numbers.

I regret to have to state that I have this year received specimens of the San José Scale from two localities in British Columbia. The attention of the Provincial Government has been drawn to the matter, and the few trees which are infested in both cases will be destroyed before another season opens. The first of these was discovered by Mr. J. W. Cockle, of Kaslo, B.C., a keen entomologist and one therefore well able to detect the enemy and give advice to the owner of the trees. It is satisfactory to find that in both of these cases the trees have been planted for a long time and date back previous to the enforcement of the San José Scale Act and the establishment of the fumigating stations.

For the San José Scale more careful treatment and persistent effort is necessary than for many other insects the fruit grower has to deal with. The standard remedy is the lime and sulphur wash which has so often been mentioned in these reports and for the making of which and instructions in its application, necessary information will be given to any one who applies for them. Prof. J. B. Smith of New Jersey recommends very highly two recently sent out proprietary mixtures: Kil-o-scale and Scalecide, which have given good results with him. They are petroleum preparations which have been prepared largely under Dr. Smith's supervision.

THE CODLING MOTH (*Carpocapsa pomonella*, L.).—The Codling Moth, which on the whole, perhaps, is the worst enemy of the fruit grower, has levied a heavy toll as usual in unsprayed orchards; but, wherever thorough work has been done in spraying regularly with the poisoned Bordeaux mixture, good results have almost invariably followed. In every part of eastern Canada where apples are grown, reports speak of injury by this insect and, as is pointed out by the Rev. Father Burke, possibly the comparative scarcity of fruit this season makes the injury by the Codling Moth seem more apparent. There is now not the slightest doubt that in all parts of Canada east of Toronto spraying orchards regularly with poisoned Bordeaux mixture, three or four times in spring, the first application to be made within a day or two after the blossoms fall and the subsequent sprayings, each ten days apart, is a satisfactory and well paying remedy for the Codling Moth. A striking instance of the value of regular spraying, year after year, was this year to be seen in the orchard of the Central Experimental Farm at Ottawa, where not an apple injured by the Codling Moth was to be found, whereas, on the other hand, in orchards just close by, where no spraying had been done, more than half the crop of apples was destroyed, also in the Botanic Garden, which lies about half a mile on the opposite side of the orchard, in the collection of wild apples and crabs, the fruit was severely infested. These it had not been considered worth while to spray, as the trees are merely grown for ornament.

The Codling Moth is normally single brooded at Ottawa and the double brooded habit of the species is not general east of Toronto. In 1905 I had an opportunity of

SESSIONAL PAPER No. 16

rearing a considerable number of the larvæ and was much surprised to find that some of these after spinning their cocoons changed at once to pupæ and gave forth the moths soon afterwards. These, however, formed only a small percentage of the whole, for by far the larger number remained in the larval state and will not pupate until next spring. The above larvæ were full grown and began to spin up July 25, and I am of the opinion that not only at Ottawa, but at some other places in eastern Canada where a partial second brood was this year noticed, this premature development of the moths was due to about a fortnight of excessively and exceptionally hot weather in July as they were nearing full growth.

West of Toronto, in addition to regular spraying, banding the trees with burlap bands to catch the larvæ of the first brood when they spin up is necessary.

It has long been a matter of wonder that the Codling Moth, which is so abundant in the States of Oregon and Washington, should not have established itself as an injurious fruit pest in British Columbian orchards. Although carefully sought for, no instance of apples infested by this insect have been detected until the present season. An insect which causes a somewhat similar injury, the Lesser Apple Worm [*Enarmonia* (*Grapholitha*) *prunivora*, Walsh] has frequently in the past been mistaken for the Codling Moth in British Columbia; but, with the exception of a single specimen of the moth sent to me by the Rev. J. H. Keen, from Metlakatla, B.C., where no apples are grown, and which he had found in his house, I have never been able to learn of the occurrence of this insect in British Columbia until Mr. J. W. Cockle, of Kaslo, B.C., sent me this autumn an undoubted specimen of the Codling Moth, which he had reared from infested apples growing in an orchard at Kaslo. It is deeply to be regretted that this insect has found a foothold in British Columbia, although this at some time was almost inevitable, from its abundance in orchards to the south. It is well for the province that Mr. Cockle, being a trained entomologist, should have been able to detect both this insect and the San José Scale before they had spread further. The matter has been brought to the attention of the Provincial Government and it is their intention to deal with both of these occurrences before another season opens.

THE WOOLLY APHIS OF THE APPLE (*Schizoneura lanigera*, Hausmann).—An insect which has been strikingly more abundant during 1905 than it has been for many years, is the Woolly Aphis of the Apple. This has been noticed all through Ontario and Quebec, and Mr. R. M. Palmer tells me that it has been more destructive in British Columbia than for many years. The injury by the Woolly Aphis is sometimes very severe in the United States, particularly by the root-inhabiting form of the species; but it has never been a very serious pest in Canada; even in British Columbia, where it is regularly much more abundant than in the East, it is less destructive than the Apple Aphis and some other well known enemies of the fruit grower. The eradication of this pest when it has established itself upon the roots of apple trees in an orchard, is a difficult matter. The methods which are usually adopted, are the uncovering of the roots and pouring in hot water almost at the boiling point, or the injection into the soil of bisulphide of carbon. Another method which has been highly praised, is digging in tobacco dust around the roots. This material can be purchased, it is claimed, from cigar factories at a reasonable amount, and, when this does not exceed one cent per pound, the tobacco is worth fully that price as a fertilizer. The form which occurs in Canada most widely, is that which may be seen during the summer and autumn gathered together in white woolly clusters on the shoots from the base of the trunks of neglected trees and upon the branches, where they cause swellings in the bark by sucking the sap and at the same time poisoning the tissues. In the vicinity of Ottawa the wild hawthorns were even more seriously attacked than apple trees in orchards, although some of these latter were so infested that one correspondent spoke of them as presenting the appearance of having been whitewashed.

The remedies for the form which occurs on the branches, are the same as are used for ordinary plant-lice; but, as these are protected by a waxy covering, it is well to

apply the liquid with considerable force and also to have it mixed with hot water which gives it greater penetrating power. A kerosenè emulsion may be made for this purpose, of the standard Riley-Hubbard emulsion diluted with six, instead of nine parts of water. Whale-oil soap solution should be applied hot and one pound in five gallons of water.

THE APPLE MAGGOT [*Rhagoletes* (Trypeta) *pomonella*, Walsh].—In the autumn of 1904 an outbreak of the Apple Maggot, known also in the New England States as 'the railroad worm,' was detected in some of the apple orchards at Como, Que. During the past season it has been found that the insect has established itself in many other orchards surrounding the first point of injury.

As there are several large and valuable orchards in this locality, much anxiety was felt by the owners of these, that the habits of the insect and the best remedial treatment should be made known to all apple growers of the district, so that by concerted action the outbreak should be controlled before more loss accrued. With this object in view, I visited Como early in October, and examined several of the orchards under the guidance of Mr. R. W. Shepherd, who kindly put himself at my disposal and accompanied me, and also helped me in many other ways to get into touch with the owners of several orchards.

One of Mr. Shepherd's own orchards had been affected last year, and this summer he had faithfully carried out suggestions of control based on the experience of those who had suffered from the Apple Maggot in other places.

All windfalls had been fed to cattle, and a herd of pigs had been kept in the orchard throughout the summer. It may be well, however, to point out, as the experiment will be anxiously watched by his neighbours, that some badly affected crab apple trees were in a sense overlooked, the fruit of which was thoroughly infested at the time of my visit. It would appear that the fruit of this class of apples does not fall from the trees when attacked, to the same extent as the larger apples. At that time, however, Mr. Shepherd at once had the fruit of these trees threshed from the boughs and destroyed. A circular letter giving the nature of the pest and advice as to the best treatment of infested orchards was at once prepared and a copy sent to every apple grower in the district. Notwithstanding the severity of the outbreak, the experience of others who have suffered loss from the Apple Maggot, would seem to give reasonable ground for hope that much may be done to reduce loss. The following letters from the State Entomologists of Maine and New Hampshire respectively, show that good results have followed the adoption of the best, so far, recognized method of prevention. The insect has been present in these States for some years.

'Agricultural Experiment Station, Orono, Me.—Your letter concerning the Apple Maggot is received. There seems to be no marked change from year to year in the occurrence of this pest here. We have in the State numerous orchards in which the trees have not been pruned for a generation at least and in which the windfalls lie ungathered. The owners of such orchards frequently complain that the trees might as well be cut down, for the "Railroad Worm" gets all the apples. On the other hand, *none of the leading orchardists seem to feel that the case is hopeless*. They recognize the Apple Maggot as a pest to guard against and believe that care in putting the windfalls out of the way is the only practical method of doing it. Thus, it is no uncommon situation to have well cared for orchards where infestation by *R. pomonella* is almost unknown, while within a few miles the owners of neglected trees say that for years they have not gathered a crop. There is one notable case of this sort in the southern part of the State, where in the midst of an infested area a very large orchard ships perfect apples every fall and no loss is caused by the maggot.

'A few successful orchardists think it pays to keep a few sweet apple trees scattered about as traps, as the flies seem always to deposit in these by preference; and the whole situation is sometimes handled by sacrificing some sweet fruit and subsequently destroying this infested lot. I trust that the outbreak near Montreal will not prove so serious as it seems at present.'—EDITH M. PATCH.

SESSIONAL PAPER No. 16

'New Hampshire College of Agriculture and the Mechanic Arts, Durham, N.H.—I have not heard of any serious trouble from the Apple Maggot this year, although it is quite common in our summer apples. I think it is somewhat worse this year than last year; but it has not caused any very serious injury, so far as I have heard. It becomes seriously injurious periodically.'—E. D. SANDERSON.

THE BUFFALO TREE-HOPPER (*Ceresa bubalus*, Fab.).—A great many specimens of rough and gnarled twigs of apple trees have been sent in from time to time, but more frequently during the last year or two, which were due to the injuries caused by small grassy-green homopterous insects that bear on the thorax two horns which are supposed to give it a resemblance to the buffalo. The only harm done by this little insect to orchard trees is by the egg-laying females, which cut two semi-circular gashes right through the bark deeply into the wood, and into each of which they insert from five to ten eggs. Each female lays between one and two hundred eggs, and consequently makes several of these gashes before she has deposited her whole supply. The eggs remain in the wood and do not hatch until the following June; each egg is about one-sixteenth of an inch long, slightly curved and yellowish white in colour. When the young hatch, they crawl out of the egg-shell which remains in the wood and prevents the wound from healing up for a long time. Young twigs of two or three years old are frequently selected by the females for ovipositing, and, if there are only a few of the scars, little injury is done; but it seems to be a habit of this insect to work somewhat in company, and frequently a single tree may be found with a great many egg-deposits in the wood, while others close by are untouched. The two slits almost meet each other but do not quite touch at the top and bottom, but the small piece of wood and bark between them dies and, together with the empty egg-shells, prevents the healing of the wound, so that, where there are many deposits on the same tree, the injury is serious and a check is sometimes given to young trees, which they do not get over.

The Buffalo Tree-Hopper while young lives chiefly upon the sap of weeds and other coarse vegetation, and very little of its food is derived from the apple trees where the young larvæ are first hatched. For a few days, at any rate, after they have first hatched, they may be seen on the trees running quickly round the branches and hiding whenever looked at. At this time, which, however, does not last for many days, good work may be done by spraying the infested trees with kerosene emulsion or whale-oil soap. It is very difficult to reach the eggs by any winter treatment, but probably spraying with crude petroleum or an emulsion of that oil might be applied without injury to the trees. The remedy recommended by Mr. C. L. Marlatt, the First Assistant United States Entomologist, is the limiting of the amount of foreign vegetation about and in orchards and nurseries. He thinks that little damage may be anticipated where the ground between the trees is kept clean and constantly cultivated. Vigorous pruning in winter, by which as many as possible of the egg clusters are removed, is also advised. The mature insects seem to be attracted by beans and some other low-growing vegetables. These then might be planted in orchards between the trees as trap plants to be afterwards sprayed with strong mixtures of kerosene emulsion or whale-oil soap, when the larvæ, nymphs or adults are seen to be numerous enough upon them to make it worth while. The time recommended by Mr. Marlatt is about July 1.

THE WESTERN HARVEST-FLY [*Cicada* (*Platypedia*) *putnami*, Uhler].—An extremely common insect in most parts of British Columbia, is a species of *Cicada* of about the same size as the well known *Cicada septendecim*, L., of the United States. This latter is known under the erroneous name of Seventeen-year Locust, but, so far as I can learn, has been never or very seldom taken in Canada. The Western *Cicada* is enormously abundant nearly every year in Vancouver Island in June; and I have found it in like numbers in the Kootenays, particularly at Nelson, where in the begin-

5-6 EDWARD VII., A. 1906

ning of July in 1896 the shrilling of the males among the aspen poplars and willows on the mountain side above the town was almost deafening. The species occurs right across the mountains, as I have specimens from Banff, and last year Mr. Dalton Tipping sent me a specimen which he had taken at Blackfalds, in Alberta.

Up to the present season no injury to cultivated trees had been complained of in British Columbia, but on July 3 last, Mr. E. Hulme, of Rock Creek, in the Boundary District, B.C., sent me samples of apple branches which had been punctured by the egg-laying females. As in the case of the other species of the genus, *C. putnami* lays its eggs in deep slits made into the wood of various trees; but the young do not feed on the wood or foliage of the trees where the eggs pass the winter; on emerging, they fall to the ground and burrow into the earth, where they attack the roots. Mr. Hulme stated that his young apple trees had been planted four years, and he had not previously noticed any injury; but this year some of the branches had been cut in four or five places.

It is hoped that this may be only an accidental injury to apple trees; but British Columbia is now becoming such an important fruit producing country and such large areas are yearly being cleared and planted to orchards, that any insect which is likely to develop into an enemy of the fruit grower is worthy of attention.

THE SLEEPY WEEVIL (*Otiorhynchus ovatus*, L.).—In my last report reference was made to the attacks of the larvæ of this weevil on the roots of strawberries. The insect occurs right across the continent and is frequently sent to the Division for information concerning its habits; but this is usually on account of the frequency with which it is found crawling about inside houses. Complaints of injury to vegetation are seldom made; but occasionally the damage done by the larvæ is considerable. Mr. E. McTaggart, of Hatzic, B.C., wrote as follows last spring:—‘May 3.—I am sending a box containing a number of small white grubs. This insect has been working for the past three or four years in our strawberries, feeding on the small white root feeders. They bid fair to put us out of the strawberry business, unless we can find some way to control them. This will be a serious loss; for strawberries are our most important crop.’

Specimens sent from British Columbia previously, showed that the larvæ of the Sleepy Weevil have also the habit of boring cavities into the caudex or short underground stem of old strawberry plants, in the same way as, and frequently in company with, the larger larvæ of the Black Vine Weevil (*Otiorhynchus sulcatus*, Fab.). Mr. McTaggart was advised to adopt the ‘one-crop method’ of growing his strawberries, by which finer berries are produced and the beetles are prevented from increasing. I find also that large numbers of the mature beetles may be trapped by putting shelters, such as small flower-pots with a little hay in them, inverted and raised from the ground on short pegs, about the beds. The beetles are largely nocturnal in habit and will make use of these shelters for hiding in by day. They can be easily cleared out by taking each pot off the peg and shaking the hay over a pan or pail with a little water and coal oil in it. They are remarkably sluggish insects and make no effort to crawl away by day.

Father Burke sent specimens from Alberton, Prince Edward Island, which he had found eating cavities into low growing apples; many fruits trailing on the ground were damaged. He had also found the beetles in the blooms of dahlias and eating the leaves of the wild buckwheat.

Mrs. Thomas Sharpe, writing from the Experimental Farm at Agassiz, B.C., on August 9, sent specimens of the Black Vine Weevil which had been found very plentifully on the raspberry bushes, and also several Sleepy Weevils which she said ‘we find all over the house. Do we carry them in on our clothes from the garden or are they some destructive house insect? We are quite alarmed at the numbers of them which we find about the floors.’

It is probable that some of these may have been carried into the house from the garden; but these insects have a well marked penchant for crawling into houses and

SESSIONAL PAPER No. 16

other places where they are decidedly objected to by housekeepers. Neither the Black Vine Weevil nor the Sleepy Weevil have wings; so they cannot fly like most other beetles and can only move from place to place by crawling.

THE STRAWBERRY WEEVIL (*Anthonomus signatus*, Say).—It is some years since a bad outbreak of the Strawberry Weevil has occurred in Canada; but in June last I learnt from Mr. Sydney H. Preston, of Clarkson, Ont., which is a few miles west of Toronto and an important strawberry producing district, that a great deal of damage was being done in the extensive strawberry plantations of that locality. Mr. Preston writes:—

‘Clarkson, June 9.—I inclose some strawberry blossoms cut by the insects which are sent with them in the box. They are doing a great deal of damage in this locality.’

‘June 17.—I grow only a few strawberries for my own use and have not seen the weevils on my own place, though I find many buds and blossoms and small berries cut through the stem, as in the inclosed sample; but my neighbours are all large growers and the complaint of damage is general. The cutting of the fruit stems is also attributed to this insect, but possibly that may be a mistake. Last season was the first in this locality that the injury was noticeable, and many growers then feared that their crops would be ruined. However, there seemed to be an abundance of fruit in spite of this.’

The habits of the Strawberry Weevil are interesting. It passes the winter in the mature beetle form, and, just before the flowers of the strawberry unfold, the insects fly to the strawberry beds and may be found in large numbers upon the flowering stems. When the female lays her eggs, she punctures a closed bud, for which purpose she generally chooses the earliest and largest. This is done with her sharp and slender beak, and the hole penetrates to the centre of the bud. She then deposits a single egg, pushing it down into the hole. Having done this, she crawls to the stem of the flower and gnaws it nearly through, so that the bud hangs down and eventually drops to the ground. Inside the cut off bud the young grub hatches and passes through all of its stages, the dead flower remaining closed around it as a protection. When the grub is full-grown, it forms a brittle cocoon of the debris, and in about a month from the time the egg is laid, the perfect beetle eats its way out. The new generation of beetles may frequently be found at Ottawa in the latter half of July and early in August. There is only one brood of this beetle, as far as known, and, as all the beetles disappear suddenly in the beginning of August, it is supposed that they go into hibernation at that time, hiding away beneath moss or among bushes and perhaps in woods, where they remain in a lethargic condition until the following spring. The varieties of strawberries chosen by the females for egg-laying are always those which produce pollen in considerable quantities, and it is chiefly upon the pollen that the larvæ feed. Varieties of strawberries with entirely pistillate flowers are not attacked; consequently, when the Strawberry Weevil is abundant, growers will do well to plant pistillate varieties as much as possible, and only enough plants of varieties which produce perfect flowers (which have both stamens and pistils) as will ensure the proper fertilization of the fruit. The number will to a large measure depend upon the variety grown and the number of flowers produced. Among the standard varieties of strawberries most highly recommended by Mr. W. T. Macoun, the Horticulturist of the Central Experimental Farm, the following may be mentioned as having proved the most satisfactory for general purposes, after being tested for several years:—

Pistillate.

Sample.

Buster.

Bisel.

Greenville.

Marie.

Warfield.

Perfect.

Glen Mary.

Beder Wood.

Enhance.

William's.

Lovett.

Pocomoke.

A reference to the good qualities of each of these varieties is made in the Report of the Horticulturist for 1904 at page 121.

Many experiments have been made to discover a practical remedy for this troublesome insect, which at different times has done a great deal of harm in Canada. Many years ago I suggested covering the plants just at the time the beetles appear, with gauze, cheese cloth, or even paper; but these methods all have the very great disadvantage of excluding the swarms of flies, bees and other insects which frequent the flowers and aid in the fertilization. Trapping the mature beetles when they fly to the plants, it is claimed, has produced good results. For this purpose the pollen-bearing plants should be planted in rows so that they may be sprayed when found to be covered with the beetles, either with a whale-oil soap solution or a kerosene emulsion. As has been pointed out by Mr. F. H. Chittenden, in an excellent bulletin on this subject (U. S. Div. of Ent. Circular 21, 2nd series, 1897), 'for the complete success of this method, it is essential that the non-fertilizing plants (the main crop) should be perfectly pistillate and bear no pollen at all.'

THE CURRANT MAGGOT (*Epochra canadensis*, Loew.).—Injury to currants both black and red by the larvæ of the Currant Fly are somewhat frequent in the West, and, unfortunately, up to the present time no very satisfactory remedy has been devised. The only treatment which has given any results, is the laborious one of removing about three inches of the soil from beneath bushes which had been infested, replacing this with fresh soil, and then treating the infested soil containing the puparia, in such a way that when the flies mature they cannot emerge. The following letters were received during the past summer:—

'Rock Creek, B.C., June 27.—I send to-day samples of gooseberries and currants which are affected with white maggots. I should like very much to know what we can do to avoid this pest. Last year we tried spraying with quassia chips and whale-oil soap solution, from the time the blossoms opened out; but it did no good whatever. The fly seems to lay her eggs when the berry is almost full grown. We have over 100 bushes and all are a complete loss. We have tried putting unslaked lime under the bushes, and we keep them well trimmed up; in fact, some of our currant trees are two and a-half feet high, but all are affected in the same way.'—MRS. BART INGRAM.

'Indian Head, N.W.T., July 3.—I send you a few currants to show you how badly affected they are. At least half the crop was stung early in the season and fell off. Those that remain on the bushes, are in the condition of these I send you. In a recent trip through Kinistino, Melfort and the other districts around Prince Albert, through which we travelled together five years ago, I noticed that the currants were all affected in the same way. It would be of advantage, I think, if you could advise farmers what to do to save their fruit.'—ANGUS MACKAY.

'McLean, Assa., July 3.—I am sending a few currants which are infested with some insect. They are beginning to fall off now. This is the third year they have been infested; but I can't find out what kind of insect it is, although I often hunt for it.'—W. J. FANNING.

The maggots are very hard to recognize when at work in the currants, and many correspondents, like Mr. Fanning, have had difficulty in detecting them. They were however, present in the specimens which he forwarded. In addition to the measure suggested above, of removing the earth from beneath infested bushes, it is claimed that much good has been done by allowing poultry to run in a plantation where the Currant Maggot is known to be infesting fruit. The birds scratch beneath the bushes and destroy large numbers of the puparia. It is probable that the eggs are laid by the female flies when the currants are quite small, as freshly emerged flies were sent to me from Vancouver Island under the date May 20.

SESSIONAL PAPER No. 16

FOREST AND SHADE TREES.

No extensive injury to forest or shade trees by insects has come under my notice during 1905, but there have been local outbreaks of some importance. In Alberta the Forest Tent Caterpillar has again stripped aspen poplars, and mention has been made of its work on maples and in orchards in Nova Scotia. There are also indications that Tent Caterpillars are again on the increase in Ontario and Quebec. The Larch Sawfly (*Nematus erichsonii*, Hartig), which appeared in a few places last year upon the native tamaracks and imported European larches, was this year much more abundant, and for some hundreds of miles along the Canadian Pacific Railway between Ottawa and Lake Superior had stripped the young tamaracks growing in the swamps along the railway. Occasional mention was also made by correspondents of the work of this insect in the Maritime Provinces. An insect which has not previously been recorded as doing harm in Canada, the Larch Case-bearer, has this year been found in considerable numbers at Ottawa on the European larch. The Negundo Plant-louse which has occasionally been so numerous upon the cultivated and wild Ash-leaved Maples in Manitoba and the North-west Territories, was again extremely abundant in some places this year. The Cottony Maple Scale (*Pulvinaria innumerabilis*, Rathvon), which for several years has been abundant on the shade trees in some of the cities of western Ontario, was during 1905 even more so than in previous years. The outbreaks of the White-marked Tussock-moth, which in previous reports have been referred to in some Ontario cities, and in Montreal, have attracted much public attention, and at last efforts are being put forth by the municipal authorities in various cities to control these destroyers of the public shade trees. In Vancouver Island, the oak-looper *Therina somnaria*, Hulst, which was complained of as being abundant last year, during 1905 swarmed in countless numbers over the oak trees in the vicinity of Victoria, B.C., and stripped them of their leaves. The Spruce Gall-louse was exceptionally abundant in 1905, and requests for information as to its life habits and the possibility of its becoming a destructive enemy of Canadian spruces, came in from many correspondents in all parts of the country. The ornamental cedars on the Central Experimental Farm were very much disfigured by the mining larvæ of a very small moth belonging to the genus *Argyresthia*. The moths appeared at the end of June and were found flying in clouds around all varieties of the American Arbor-vitæ, or so-called White Cedar. The full life history and the exact identity of the species are not yet worked out; but young larvæ were found in the twigs early in spring, the moths emerged in the latter half of June, and the young larvæ are at present in enormous numbers passing the winter inside the small twigs. As yet, no parasites have been bred. What was apparently this same species, was sent to me in 1899 by Mr. Thos. Ware, from Plattsville, Ont., Writing of this occurrence, Mr. Ware says: 'The insects did my cedars considerable damage in 1899; and not only mine, but whole cedar swamps lost their green and looked quite brown. The trees have since been slightly affected each year, but not to any great extent. I saw a few of the insects this summer but the hedge has not suffered.' The injury to ornamental shrubs, and there are many varieties of the white cedar grown as such, has certainly been serious this year at Ottawa. So far, no remedies have been tried. The Fir Sawfly, *Lophyrus abietis*, Harr., appeared upon cultivated White Spruces in two or three places in Manitoba. Mr. T. C. Court sent specimens from Petrel, Manitoba, and their work was noticed upon cultivated spruces around the government offices in Winnipeg as well as in the sand hills south of Douglas, Man. This insect occurs in troublesome numbers from time to time in Manitoba, but is easily controlled by poisonous sprays if promptly applied as soon as the larvæ are noticed. A very similar larva, but probably of another species of sawfly, was sent to me by Mr. H. H. Miller, M.P., from Hanover, Ont., where it had been found in destructive numbers upon a cedar (arbor-vitæ) hedge which was much valued by its owner.

5-6 EDWARD VII., A. 1906

THE SPRUCE GALL-LOUSE (*Chermes abietis*, L.).—An insect which is spreading widely through the Dominion and which of late years has been the cause of much anxiety among the growers of ornamental spruces and even of lumbermen, is the Spruce Gall-louse. This is the insect which causes the elongated green cone-like galls on the twigs of the native Black and White Spruces and of the imported Norway Spruce. These galls have been more than usually abundant during the summer of 1905, particularly upon young transplanted trees. Specimens have been sent in from many places.

Although undoubtedly the Spruce Gall-louse does injure trees to a serious extent when present in large numbers and also gives them a very unhealthy and unsightly appearance, still I do not know of any actual instances where it has killed trees outright.

About the end of July the galls begin to dry up, and the cavities at the base of the leaves open slightly and allow the young gall-lice, of which there are several in each cavity, to escape. These then crawl out and rest upon the leaves, and after a short time they moult and appear with wings. This is the time when the insect spreads from tree to tree; for these mature females fly to fresh trees or to fresh branches on the same tree and begin to lay small, pale yellow eggs, which are in clusters of from 20 to 50 together. From these eggs young plant-lice hatch, which remain on the twigs and at the base of shoot buds until the following spring. Many of these young lice, however, die before spring, and those which do survive the winter, may be found at the bases of the buds in May, enveloped in a coat of white waxy threads. These young plant-lice are very small when winter sets in; but in spring they grow rapidly, and, after moulting the old winter coat, they secrete another of much finer texture and much more conspicuous, of long woolly threads. When full grown these insects, which are all females, lay clusters of upwards of 300 eggs at the bases of the young shoots just about the time the spruces are beginning their new spring growth. The eggs are light yellow in colour, extremely small, about one-sixtieth of an inch in length, and each one is attached by a slender thread-like stem about twice the length of the egg. In about a week the very minute nymphs crawl out from beneath the woolly mass consisting of the dead body of their mother, and crawl on to the young shoots, where they take up their position at the bases of the leaves which have already begun to swell and form galls before their arrival, owing to the presence of their mothers during the winter. The green cone-like gall grows rapidly during June; the base of each leaf swelling and expanding so as to form a cavity which gradually develops and covers in some of the young insects. In time this cavity is closed all but a narrow semi-circular slit at the top. It is claimed by Prof. R. A. Cooley, who did very careful work on this insect while at the Massachusetts Agricultural College, that, in general, all of the nymphs which enter one gall, arise from the egg cluster laid by one female. As the gall grows in size, these cavities are enlarged, this leaves room for the increased growth of the insects which it contains.

As stated above, these insects do not become full grown and emerge from the galls until the end of July or during August. The remedies for the Spruce Gall-louse, unfortunately, cannot be applied when the insects occur on very large trees and in forests; but, upon hedges and in ornamental grounds good work has been done by spraying the trees at the time the young plant-lice are exposed on the trees, viz., in May, and after they emerge from the galls in August. Good results were secured by spraying with a tobacco and soap wash made by soaking ten pounds of tobacco leaves in 3 or 4 gallons of hot water for six hours, the liquid strained off and two pounds of whale-oil soap added. When the soap is all dissolved, the mixture can be diluted to 40 gallons. Two or three applications should be made at short intervals.

THE LARCH SAWFLY (*Nematus erichsonii*, Hartig).—About 20 years ago the Larch Sawfly was imported into America, probably with trees sent to the Harvard Arboretum and Botanic Garden at Cambridge, Massachusetts. From that point it seems to have

SESSIONAL PAPER No. 16

spread widely and very rapidly northward. In 1882 it reached Canada, and for three or four years after that did an enormous amount of injury by stripping the leaves from the tamaracks, or American larches. The attack was very severe, and, although from the injury being done comparatively early in the season, the trees were able to push forth a certain amount of foliage; after three or four years of being stripped, the larches over millions of acres, and practically over the whole of eastern Canada, were almost wiped out. With this large destruction of its food plant the insect practically disappeared, and little has been heard of it until last year, when it again became noticeable upon ornamental European larches and in a few places was observed on the young growth of larches in swamps. During the past summer there has been a marked increase in the numbers of the larvæ or false caterpillars. The injury is mentioned incidentally in correspondence from many points. Rev. Father Burke writes from Prince Edward Island:—‘I am sorry to say the Larch worm is again appearing on the new growth, and I fear we may have it much more abundantly next year.’ In the Nova Scotia Crop Report for November, 1905, a correspondent writing from Richmond county says:—‘Insects have again been destroying juniper trees.’ This is a reference to the Larch Sawfly. The American larch, known also extensively in this country under its Indian name of the *tamarack*, is called in the Maritime Provinces by the inaccurate name of ‘juniper,’ a name which is also curiously, and with equal inaccuracy, given in the upper Ottawa country to the Banksian or Jack Pine. In New Brunswick I saw evidences of the work of the Larch Sawfly at several places along the Intercolonial Railway and in Ontario for hundreds of miles along the Canadian Pacific Railway between Ottawa and Lake Superior. The larches at Nepigon, Ont., north of the lake, showed no injury, and I am under the impression that so far this new outbreak of the Larch Sawfly has not as yet reached west of Lake Superior. The tamarack swamps west of Nepigon were scanned carefully in passing along the railway, and a large swamp was examined more critically near Douglas, Manitoba, but no trace of the larvæ was seen. Specimens of the larvæ were sent from Burlington, Ont., by Mr. R. C. Cummins at the end of June.

A feature of the last outbreak of 1882 to 1885 was the rapidity with which the attack spread and the suddenness with which it disappeared. Occasional specimens of the sawfly or of the colonies of larvæ have been seen from time to time since 1885; but there has been no noticeable destruction until the present year. The territory over which this insect is known to have spread in the old outbreak, is all through Ontario, Quebec and the Maritime Provinces, right up to Labrador (*teste* Dr. Robert Bell and Mr. A. P. Low). We have no information relating to the vast tamarack swamps north of Saskatchewan and Alberta; but there is little doubt that this enemy spread through all districts where the American larch grew naturally, and that the depredations of this one insect resulted in an enormous loss to the Dominion in one of its valuable assets. Unfortunately, no remedy can be applied over the vast areas of forest where the insect is likely to occur, should it increase again; but upon ornamental grounds small groups of trees can be easily protected by the ordinary spraying methods. The best poison probably for this insect would be a spray of Arsenate of lead 1 lb. in 40 gallons of water.

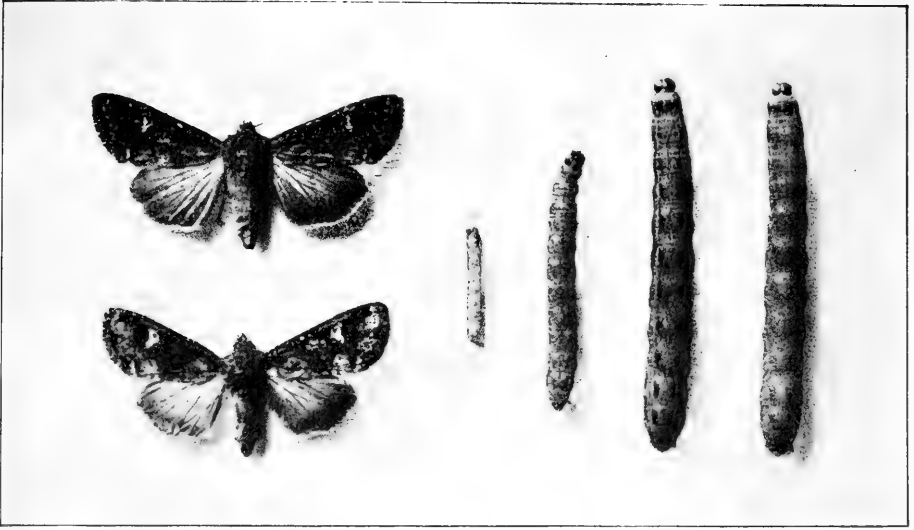
THE LARCH CASE-BEARER (*Coleophora laricella*, Hbn.).—In the month of May last the young leaves of the European and other larch trees on the lawns and in the Botanic Garden of the Central Experimental Farm, were seen to present a bleached white appearance; and, upon examination, it was found that the upper ends of the leaves had been hollowed out and were shrivelled. It was then found that this work had been done by large numbers of the small European Elachistid moth *Coleophora laricella*, Hbn. Although this insect has been recorded as injurious to larches in America on a few previous occasions, this, I believe, is the first occurrence of the Larch Case-bearer in Canada. Dr. Howard has kindly referred me to the American literature of the subject and tells me that he himself saw the larvæ very abundant some years ago in a

larch plantation near North Andover, Mass. In 1886 Dr. H. A. Hagen published in the *Canadian Entomologist*, an article on its injuries to the European larch in Massachusetts. In 1892 Mr. J. G. Jack, as related in *Insect Life*, vol. IV., p. 105, states that the insect had been introduced into Massachusetts for a number of years, and that its ravages had sometimes been quite noticeable in the Arnold Arboretum. Mr. Jack wrote from Berlin in an article entitled 'Notes of a Summer Journey in Europe,' which appeared in *Garden and Forest* for February 24, 1892, p. 87, and says of this insect that 'the European larch is sometimes seriously injured and is often killed by the larvæ of this moth, which eat out all the interior of the leaves, leaving only the dry, hard, shrivelled epidermis.' He also points out that the Japanese larch, both in Germany and at the Arnold Arboretum, is not attacked by the insect.

The numbers of the larvæ upon the trees at Ottawa in May last were not large enough to have any serious effects upon either the growth or appearance of the trees; but I regret to find this autumn that the small cases of the larvæ are enormously more abundant than they were last spring. The winter cases are very slender and vary from $2\frac{1}{2}$ to 4 millimetres in length by about half a millimetre in diameter. They are open at the end and are almost cylindrical in shape, like a cut off leaf. For that reason they are easily overlooked. There were among these larval cases a very small percentage which were curved after the manner of the winter cases of the Cigar Case-bearer of the Apple; but it is possible that these may have been the cases of another species. The cases of the full-grown larvæ of the Larch Case-bearer are after the same pattern as the winter cases, but are thicker and resemble more nearly those of the Cigar Case-bearer by being tapered slightly to each end. They are very little longer than the winter cases but have a much larger diameter, being over one millimetre at the widest part; and the end is somewhat pinched in. The colour is pale drab. The caterpillars have a curious habit, when full grown, of fastening themselves in the centre of a fascicle of leaves, where they are very difficult to detect. There is only one brood in the year, the moths of which appear in June. They are very small, not expanding more than one third of an inch when the wings are opened, of an ashy satiny gray colour, with long, slender antennæ. After pairing, the females lay their tiny yellow eggs on the needles of the larch. These soon hatch, and the larvæ eat their way into the slender needles of the empty skins of which, subsequently, they make the slender cases in which they pass the winter, attached to the twigs of the trees. As soon as the buds begin to swell in spring, these minute caterpillars revive and feed upon the young leaves. When a caterpillar attacks a leaf, it eats a hole in the side, and, as it consumes the interior portion, it protrudes its body from the case until it can reach no further without leaving the case. In spring the young caterpillar grows rapidly, and its winter case soon becomes too small for it; so, it is split down the side, and the empty skin of another leaf is inserted. This operation is repeated from time to time when necessary, until full growth is reached. Some cases from successive additions have a ridged or striated appearance. Pupation takes place inside the case, and the moths emerge from the upper end. Up to the present time nothing in the shape of a practical remedy is recorded.

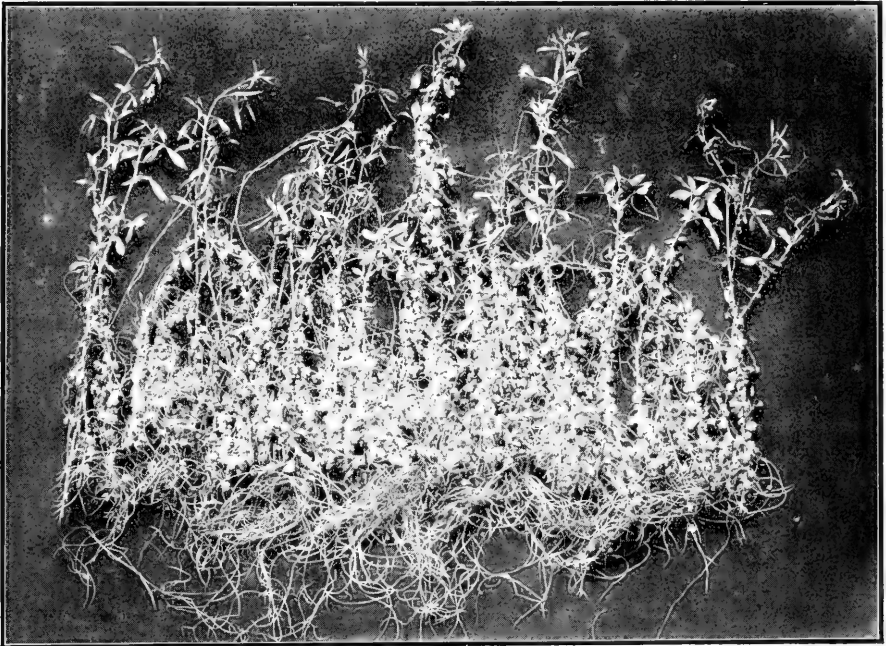
Through the kindness of Mr. A. Schreck, of the German Consulate, in Montreal, I have received the following interesting account of the habits of this insect, in Germany, from Mr. Rudolph Japing, Forest Assessor, Muenden, Hanover, Germany:

'The moths of *Coleophora laricella*, Hbn., fly during the day time in May and June. The females lay yellow eggs on the needles, which in 6-8 days turn to a grayish colour. Upon hatching the young caterpillar eats its way into a needle, consumes the interior, and from the empty skin makes a small bag in which it lives until September. During winter the caterpillar remains in this bag, generally on the top of the branches, more seldom in crevices of the bark. In spring it is again found mining in the new needles, and soon has to enlarge its bag, which it does by joining to it a part of a newly hollowed out needle. In this bag the insect changes to a chrysalis in April and May, the moth emerging at the end of May.



THE SPINED RUSTIC (*Barathra occidentata*, Grt.)

Moths (the lower, typical), and caterpillars, young, half grown and full grown.



CLOVER DODDER ON ALFALFA.

(Figure kindly lent by "Farmers' Advocate," London, Ont.)



SESSIONAL PAPER No. 16

'The injury to the trees from these insects can be very great, especially in spring. The growth stops and the trees become feeble and are thus susceptible to canker, which often follows the damage done by the insect. The Larch Case-bearer is mostly found on trees from 10 to 40 years old.

'In nature the insects are devoured by many birds, and in autumn they are often destroyed by protracted rains and by early frosts.

'Trees badly infested by these insects should be cut down from the middle of June till the end of August. This causes the leaves to dry up and the caterpillars die of starvation. It would be better to burn the needles, but this is possible only in nurseries. In the extensive forests of Canada it would be difficult to do anything effective to destroy the insects.'

THE WHITE-MARKED TUSSOCK-MOTH (*Hemerocampa leucostigma*, S. & A.).—Of recent years the shade trees in several of our Canadian cities have been very much disfigured by the caterpillars of this well known native insect. Energetic measures have been taken by the local newspapers and the civic authorities, particularly in Toronto and Montreal, to reduce this quite unnecessary injury to the fine shade trees in these beautiful cities. Public meetings have been called, and the advice of specialists has been taken. There is nothing of any importance which is still unknown of the habits of this insect, and all that is now necessary is the prosecution of a vigorous campaign at once, so as to control as soon as possible, if not actually to wipe out, this unwelcome guest which has done so much harm. The subject was treated of at some length at a public lecture which I had the honour of delivering before Toronto University in February last, and again before the Toronto Horticultural Society in June. The discussions were reported at length with further comments by the *Toronto Globe* and other newspapers. A similar action was taken in the city of Montreal where a conference was summoned by the Montreal Natural History Society, and a thorough discussion of the subject took place. The *Montreal Star*, *La Presse*, and other newspapers, published several articles in their daily editions, and at request I prepared a full article for the *Weekly Star and Family Herald*. The course of action recommended by me at all of the above meetings was to destroy the caterpillars by spraying the trees while the caterpillars were young, with arsenites or other active poisons, and the collection of the conspicuous egg masses during winter. Prof. D. P. Penhallow, of McGill University, has taken an active and useful part in distributing information on the subject, and in drawing the attention of the public of Montreal to this important matter, and his efforts have been ably supplemented by Mr. H. H. Lyman, who has materially assisted with expert advice as to the correct natural history of the insect. It is to be hoped now that public attention has been drawn to this matter, vigorous measures will be adopted, and that private citizens will second the efforts of the municipal authorities by attending to their own trees and gardens, which cannot be well reached by officials. In this way this insect may be very much controlled. Its possibilities for injury are only too well known by what it has done in New York, Rochester, Cleveland and other cities in the United States.

THE VANCOUVER ISLAND OAK-LOOPER (*Therina somnaria*, Hulst).—The beautiful oak trees which form such an attractive feature of Victoria, Vancouver Island, have again this year suffered severely from the attacks of the caterpillars of this geometrid moth. It was hoped from the large numbers of parasites which were reared from the pupæ last autumn, that the injury during 1905 would have been less than in the preceding season. These hopes, however, were doomed to disappointment, for the caterpillars occurred last spring in countless myriads and stripped every vestige of foliage from most of the oaks around the city and for several miles out into the country. Mr. J. R. Anderson wrote under date June 23:—

'*Therina somnaria* is already at its deadly work worse than ever. The oaks in some places are already stripped of their leaves, and other plants are being attacked

by the famished larvæ, which are as yet only half grown. What is to be done, I do not know, unless the parasites increase. Treatment of the trees with poisons over miles of country is of course out of the question.'

There is some doubt among entomologists as to the exact status of *T. somniaria* as a species. It has usually been considered that it is a form of *Therina fervidaria*, Hbn., but the difference in the food plant, *fervidaria* having been found in nature, here at Ottawa and in other places, feeding on conifers, seemed to indicate, more perhaps than the slight differences in markings on the mature insects, that the western form would probably prove to be a different species. Having received eggs from Mr. Anderson early in the spring, as soon as the young larvæ hatched, they were placed upon fresh twigs of the hemlock spruce (*Tsuga Canadensis*), and, although it cannot be said that at any time they fed upon the hemlock with avidity, nevertheless some specimens were carried through upon this food plant alone and gave moths at the usual time. Moreover, on Vancouver Island, when travelling with the Rev. G. W. Taylor, in September last, a few miles out of Victoria, we observed one instance where the larvæ, after having stripped the oak trees, had spread for a short distance into a grove of Western Hemlock Spruce and Douglas Fir, the leaves of which to some extent had been eaten by them. Mr. Taylor, who is a specialist upon the Geometridæ considers it more probable that *Therina* (*Ellopia*) *somniaria* of Hulst is a variety of *Therina fiscellaria* of Guenee, which is a segregate from the old composite species *Therina fervidaria* of Hubner, than that it is identical with the type species *T. fervidaria*, Hbn. He says:—'It may be said that *T. fiscellaria* and *T. somniaria* feed as larvæ on deciduous trees, while true *T. fervidaria* feeds on conifers.' It would appear from experiments which I have carried on at Ottawa, that this generalization is accurate, and, although eggs of *somniaria* from Vancouver Island gave larvæ which under compulsion fed on hemlock spruce, a conifer, others from the same batch of eggs ate oak, their natural food plant, much more readily. *T. fervidaria* at Ottawa feeds naturally on hemlock spruce.

From pupæ received from Mr. J. R. Anderson, which had been collected at Victoria, several specimens of *Pimpla scriptifrons*, Cress., were reared, thus adding one more species to the many parasites which are already known to prey upon this insect. I saw the mature moths and the parasites emerging in enormous numbers in Victoria on September 18 last. Trees, fences, and sides of houses were swarming with the pretty soft brown, large-winged moths.

THE APIARY.

The Apiary, as in the past, has been under the management of Mr. John Fixter, the farm foreman, whose report I append herewith. The same experiments which have been carried on for some years have most of them been repeated on account of the large amount of interest which has been evinced in the subject by correspondents and visitors to the Central Experimental Farm. The services of Mr. Fixter have been asked for at a great many meetings of bee-keepers, and, whenever his duties at the Central Experimental Farm would permit of it, he has attended these meetings and given addresses.

REPORT OF MR. JOHN FIXTER.

SEASON OF 1905.

The season of 1905 has been a fairly good one; especially in western Ontario the honey crop has been excellent, both as to quality and quantity; parts of Quebec report medium crops, while other sections report heavy crops. Correspondents from New Brunswick, Nova Scotia, Prince Edward Island, Manitoba, the North-west Territories,

SESSIONAL PAPER No. 16

also British Columbia, report medium to heavy crops and that bee-keeping is on the increase in each of those provinces.

The season opened very late in the Ottawa valley, there being so much cold wind at the end of March and up to April 11. It was necessary to keep the bees in their winter quarters until this latter date when the colonies were placed on their summer stands after being confined in their winter quarters for 139 days. The temperature, 52 degrees, and the weather bright and mild on April 11 were most favourable for the cleansing flight of the bees. Then followed many days of cool and windy weather, which kept the bees confined to their hives; this continued the greater part of April, the average temperature for April being 41.14. May set in warmer, the bees gathered pollen freely, and built up fairly well. During the long cold spell in April it was found necessary to feed the bees to keep up brood rearing and to prevent spring dwindling.

The number of colonies on November 23, 1904, was 50, all of which came safely through the winter. Of these two were sent to the Experimental Farm at Nappan, N.S. Eight colonies being rather weak were doubled with others, leaving 40 strong colonies to begin the season of 1905. These were again increased by swarming to 50 colonies, when the hives were put into their winter quarters on November 7, 1905. They all weighed then over 50 pounds each. The honey crop at the Experimental Farm Apiary has been a fairly good one, the average yield being 73 pounds per colony, spring count.

EXPERIMENTS ON HOW TO PREVENT SWARMING.

I.—*H. G. Sibbald's Plan.*—For this test six colonies of bees in eight-framed Langstroth hives were selected weighing on an average 48½ pounds each. All were examined from time to time for swarming. On June 10 there was no sign of swarming. At that date each colony had abundance of brood and a considerable amount of new honey. On June 15 they were again examined. Three colonies were found preparing to swarm. Those three colonies were set off their old stands on other stands a little to one side. New hives were placed on the old stands thus left vacant. Each one of these contained two empty combs and five empty frames with two inch starters of foundations. Next, one frame of brood with queen-cells on it, was taken from each one of the old colonies that had been set to one side, making sure that we did not get the queen, and placed with the adhering bees in the hive between the two empty combs. The extracting super that had previously been removed from the old colony, was placed on the new hives with all the bees it contained. On June 19 a second examination was made. One more colony was preparing to swarm; this one was treated the same as the former three. The old colonies that had been manipulated, were examined, and all queen-cells were found to be destroyed. The old colonies were then placed on their original stands, removing the one frame of brood from the new hive, destroying all queen-cells on it and placing it in the old colony. Any bees that remained on the starters were transferred to the old colony. The extracting super that was taken off the new hive was again placed on the old colony along with the bees it contained, making one very strong colony. The fourth colony that was found preparing to swarm, was treated after four days in the same manner as the three former colonies. The other two colonies did not swarm during the season. At the close of the season we had six very strong colonies, with plenty of stores for winter and 468 pounds of extracted honey.

II.—*Forced or Shaken Swarms.*—For this test six colonies of bees in 8-framed Langstroth hives were selected, weighing 49½ pounds each. Examined on June 10 they showed no sign of swarming; there was abundance of brood and considerable new honey. June 15 a second examination was made; four colonies were preparing to swarm. The two remaining colonies did not swarm during the season.

Six other hives are previously prepared for swarms, each containing, in the order named from left to right: four dummies, one starter, one worker comb and two starters. One of these hives is brought and set on a stand directly behind one of the hives to be treated. The operator removes the first two dummies (Nos. 1 and 2) from the left or nearer side of the new hive, and puts them on one side. He then lifts from the brood chamber of the old hive the comb nearest to him, shakes it almost free of bees, and places it in the new hive next the left wall. The next comb in the old hive has a double space for shaking off. After being shaken it is placed beside the first, and the return motion of the hand carries the dummy (No. 3) from the new hive to the old one. Comb No. 3 is shaken, carried to the new hive, and dummy No. 4 is brought back. The fourth comb changes place with the first starter, and so on. When the eighth comb has been shaken in its own hive and transferred to the new, the brood chamber of the old hive is filled up with the remaining two dummies, Nos. 1 and 2. We then put supers on again, close the hive and the bees have been swarmed.

On the seventh day after shaking, the four old colonies were removed to another location. Most of the bees that were flying went with the shaken swarm, leaving the old colony so weak that it did not have any inclination to swarm, and only made sufficient honey to carry it over winter.

At the close of the season we had from this test 10 colonies and 432 pounds of extracted honey.

EXPERIMENTS IN IMPROVING STOCKS OF BEES.

Every farmer knows that there are great differences in his cows, hens, &c., but there is too often an idea that all bees are alike, and that bee-keeping is all a matter of luck. If you observe closely, you will find that one colony of bees may give you good returns, while another just beside it, does nothing in the surplus chamber. Bees are by no means all alike. They differ in disposition, temper, industry, and in other ways. It is worth while for you to have the best. Fortunately the change from poor to good stock may be made more rapidly than with other stock, and at less expense. By paying out a dollar or two for a queen, you may change a colony of poorest black bees to Italians. All you need to do is to send off your order to a reliable queen-breeder, such as advertise in our bee journals and agricultural papers, and the queen will come by mail, with directions for introducing it, which are easily followed. As a worker bee only lives about six weeks in the honey season, and, as the new queen will be laying from one to three thousand eggs in a day, you will see that, if you get an Italian queen into a colony, it will not be a great while until all the bees in the hive are Italian. Even if you do not change from one kind of bees to another, it is generally a matter of advantage to introduce fresh blood occasionally. In any case, whether you get fresh stock from outside or not, whether your bees are Italians or hybrids, there is always something to be done in the way of improving your stock, so long as any one of your colonies is better than the others.

How are you to know which are your best colonies? By keeping track of their performance, and putting it down in black and white. You can keep account of the amount of surplus honey you take from each colony, and set it down at the time. The next year you can select the best colony for your queen-breeder, and a certain number of the next best colonies for drone rearing. One thing, however, must be taken into consideration, and that is, whether there has been no change of queens in any of these colonies. The colony that gave you the largest amount of surplus last year, may have got a new queen last fall or this spring; the young queen may also have met a drone of poor stock, and from this you do not wish to breed. You can, therefore, count only on those colonies that have made a good record and still have the same queen with which they began the season last year. You must also take into account any special advantages or disadvantages. For instance, if from colony No. 1 you took two frames of brood in the spring to give to No. 2, and you then found that No. 2 stored just a

SESSIONAL PAPER No. 16

little more surplus than No. 1, it would not be fair to rate No. 2 as better than No. 1. The matter of swarming also comes in. A colony that has cast no swarm throughout the season, will be expected to store more surplus than either the swarm or the mother colony, generally it will store more than both together. Nearly always, however, it will be found that the bees that do the most work, are the least given to swarming; so, the swarming of a colony counts against it in making out its character.

In the ordinary course of management, where bees are left to their own way, and all the increase is through natural swarming, there will, of course, be the most increase from the colonies most given to swarming, which means that the general character of the Apiary will run toward swarming rather than storing. We want, however, to have the tendency not to swarm. There is a way in which a good deal can be done in the way of improvement, even by those most skilled in the management of bees.

Having decided which one, or two, or three, are the best colonies you have, watch for the first one that swarms. Suppose Nos. 1, 2 and 3 are your best, that No. 4 is the next strongest, and the rest follow in the order of their strength; 5, 6, &c. Suppose No. 2 swarms; hive the swarm and put it on the stand of No. 2. At the same time, put the old No. 2 in place of No. 4, and put No. 4 in a new place. All the field bees that were in No. 2 will join the swarm, making it good for work. The old No. 2 (now No. 4) will thus be deprived of its field bees, but on the other hand it will get all the field bees that belonged to old No. 4. In about eight days No. 2 will have a young queen matured, and will send out a swarm. You will now proceed much as you did before. Hive the swarm and put it in the place of No. 2, and put No. 2 in place of No. 5, putting No. 5 in a new place. The field bees of old No. 5 will strengthen No. 2, now on No. 5 stand, and in a day or two it will send out another swarm. Proceed as before, putting No. 2 in place of No. 6, and so on as long as swarms issue. In this way you have, perhaps, no swarms from old Nos. 4, 5, &c., but in their place you have swarms from No. 2, all of them having queens of your best stock. When No. 1 swarms, or No. 3, you can treat them the same way.

There is, of course, the possibility that No. 1 or 2 may not be among the first to swarm. Take frames of sealed brood from colonies that you do not want to swarm, and give them to one of your best colonies, while delaying the swarming of those from which the brood was taken. Of course, when you take these frames of sealed brood, you will merely exchange them for frames that have little or no sealed brood in them.

QUEEN REARING.

Rearing queens has become a regular trade, and some bee-keepers make a business of shipping queens by mail to those who wish to purchase. Although it may not be desirable for the farmer with only a few colonies to go into the subject fully, he should know enough about it to rear the queens at times, for his own accommodation.

When a colony prepares for swarming, a number of queen-cells are started, six, eight, ten, possibly many more. As soon as the first one of these is sealed, the colony is likely to throw off a prime swarm. Six or seven days after this swarm has issued, the mother colony may divide up into two or more parts, each part being called a nucleus, the word 'nucleus' merely meaning a very small colony. You will generally have enough queen-cells in each nucleus without any attention on your part, but not always. Sometimes you will find a large number of queen cells on one comb, and some combs without any. So, it might happen that if you give the matter no attention you might have a nucleus without any queen cell.

Another thing must be considered. A large proportion of the queen cells are built on the lower or outer edges of the combs. If these were left in the old colony without dividing, they might be all right; but when these combs are used as nuclei,

it is harder for the smaller number of bees to keep them warm, and when a cool night comes, the bees will shrink away from the edges of the combs, and the queen cells will be chilled. Hence, you must see that each nucleus has at least two or three good queen cells where they will be sure to be inside of the cluster of bees in the coolest nights. So you will cut away cells from the edges of the combs and from combs that have them to spare, and fasten them where required. To cut out the cells, you may use a pocket knife with a very sharp, thin blade that is more than an inch long. You need not cut away more than enough to get all the cell; but be very careful not to cut into the cell; also not to let one of the cells fall, for while the young and tender queen is in the cell, a fall may cause a defective wing or leg.

To fasten a queen-cell where you want it, use a very slender wire nail an inch and a half long. Push the nail through the base of the cell, but be sure it does not enter the cavity of the cell. Nail the cell right over some of the brood, for it will be more surely taken care of there than if separate from the brood.

It may be noticed that the bees build queen-cells with the points hanging downward, but it is not important that you should have them in exactly the same position. A still better plan than a nail to fasten a cell, is a staple, the staple being an inch and a half wide with points one inch long. Lay the cell against the comb, put the staple over it so that the cell is at one side of the staple, and then sink into the comb the staple point that is farthest from the cell. Possibly you may be inclined to think that because only one queen is to be reared in a nucleus, there is no need to have more than one queen-cell. That would be a mistake. While most of the cells reared by a colony preparing to swarm may be of the very best that colony can rear, it is not safe to assume that all are equally good. Some cells may contain poor queens, and some cells may contain nothing but a dead larva. So it is wise to have a number of cells in a nucleus, at least two or three. The bees will be likely to use the best. You will be able to see a difference in the appearance of the cells, and while you are dividing the cells among the nuclei, you may as well see that each nucleus has its fair share of the best-looking cells. The best cells are generally among the largest and longest, and are deeply pitted over the surface. A stubby cell that is not pitted but has a smooth surface, is not likely to be good. When the young queen is five to eight days old, she will fly out on her wedding trip, and about three days later she will begin laying. It may be well not to look for eggs till the queen is perhaps two weeks old, for at first the eggs are few, and not easily found. If you do not find eggs when the queen is two weeks old, you are not likely to find any later—the queen has been lost on her wedding trip or there is some other trouble. It is a good plan to give a nucleus a frame of eggs or unsealed brood from a choice colony when the young queen is four or five days old. If some ill has befallen the queen on her wedding trip, or if she has entered the wrong hive, the bees will start queen-cells from this young brood. This young brood seems also to have a sort of stimulating effect on the bees, and it is believed it may hurry up the young queen in her work of laying.

CARE OF EMPTY COMBS.—REMEDY FOR BEE MOTH.

Almost any bee-keeper will have honey-combs that are for a time unoccupied by bees; even if through no other cause, colonies may have died in winter, leaving combs empty or containing honey or pollen. Such combs are valuable property and will repay the care required to preserve them. The three principal enemies of unoccupied combs are mould, mice and moths.

Combs kept in a damp, close cellar are likely to be affected by mould. This cannot be entirely prevented where bees are wintered in the cellar; for, even if no colonies die, it may happen that some of the outer combs unoccupied by bees will be covered with mould. Fortunately, the remedy is not difficult. Put a mouldy comb next the brood-nest of a prosperous colony in the working season, and you will be surprised to

SESSIONAL PAPER No. 16

find how soon the bees will clean it up so that you will hardly recognize it as the same comb.

Mice must be kept away from combs by shutting these up in hives or in such other place where the mice cannot enter. But be careful that you do not pen the mice in with the combs.

The chief enemy of the apiarist is the Wax Moth. If a colony dies in the spring and the hive remains unnoticed on its summer stand, it is almost certain that, before the summer is over, you will find it containing a solid mass of webs and cocoons, with perhaps not a vestige of comb left. You may have sealed up the hive moth-tight before it is warm enough for a moth to fly; the result will be the same; for the eggs of the moth by some means have been laid, during the previous fall, in the hive, notwithstanding the presence of the bees. It is, however, not an easy thing to make a hive moth-tight, for a moth will squeeze through a much smaller crack than a bee. The right thing to do with a hive full of combs upon which a colony has died, is to get the combs as soon as possible in the care of a strong colony of bees. Especially if of Italian blood, the bees will make short work of cleaning out the worms before they are large enough to do much harm.

There will be little danger to the combs from the moth until the weather has become warm and bees have been flying for some time, say about the time of apple bloom. When a hive is noticed with unoccupied combs, clean out all dead bees, and put it under a hive occupied by a strong colony. If there should be any entrance directly from outside into the upper hive, close it up, so as to oblige the bees to pass through the lower hive in going in and out. Keep the entrance very small the first few days, for fear of robbers. After the colony has had this lower hive in charge for about a week, so as to get it cleaned out and get used to the work, you can give it a second hive of combs to clean out, putting the second in the place of the first.

If colonies have died in hives in the cellar, there will not be the same need of haste as to getting them in care of the bees. Indeed, it may not be a bad plan to take into the cellar hives whose bees have died on the summer stand; for in the cellar the worms will hardly get a fair start until the next spring, when the unoccupied combs will be needed to form swarms. It is well, however, to look at them occasionally to see that they are all right, for it is not difficult to see where the worms have run their silken galleries. The question is often asked whether it will do to hive a swarm in a hive in which a colony has died. Unless such a hive is exceedingly filthy, the bees will promptly clean it up, at the same time being saved much labour in building new combs.

It is well to know that freezing destroys the worms. So a hive of combs that has been left out all winter, is in no danger of worms until well along in warm weather, when moths have had time to mature and to lay eggs. If such combs are hung up in an airy place with a space of an inch between them, they will almost surely be safe from worms throughout the summer, and indeed worms may not trouble them all summer if left in the hive in their usual position.

If for any reason it is desired to kill worms in combs, sulphur is the material usually resorted to. A very little of the fumes of burning sulphur will finish the worms when they are quite small; but, when full grown, it takes a very heavy dose; so it is well first to pick out the larger ones by hand. For this take a sharp pointed knife and pick open the comb at one end of the silken gallery for half an inch, then commence at the other end and tear it open the whole length. This will drive the worm along till it comes out of the hole you first made. You can end its existence by what means may seem best. To fumigate a hive with sulphur, set into a pan or kettle partly full of ashes a smaller vessel of *iron*. In this put the sulphur and throw on it a shovelful of live coals or a red hot iron. This must be in an empty hive or some tightly closed box or chamber so that the fumes cannot escape. Great care must be exercised so that the fire does not extend to the surrounding wood. The combs placed over the burning sulphur may be prevented from catching fire by means of a

piece of old sheet-iron placed under them. It must be further remembered that burning sulphur destroys only the worms, not the eggs. So, it may be necessary to treat the combs a week or two later, when any eggs laid will have hatched. Combs of honey for table use are not likely to be infested with worms; but in the case of black bees, especially if the combs are left too long in the hives, there might be some worms. The dose of sulphur for these may be lighter than for brood combs; if the dose is too heavy, the white combs will assume a greenish colour, which, however, does not hurt them for eating.

When extracting combs are extracted for the last time in the season, it is the practice of most bee-keepers to allow the bees to lick them dry. A hive full of such combs may be placed over a colony, a propolis quilt with a small opening through it, having first been placed over the brood frames, and this allowing but one or two bees to pass at one time. Thus, the bees are not so apt to break down the combs and there is less danger of robbing; but a surer way is to set the hive at some distance from the apiary and let the bees have free play at it. After being thoroughly cleaned, all hives containing combs should be removed to a dark room until late in the autumn, and then to a building where they will get the full benefit of frost during the winter.

UNFINISHED SECTIONS.

At the close of the honey harvest there will always be more or less of the sections unfinished, the number varying greatly in different years. It will happen some years when the season is poor, that none will be finished. Even in the best of years there will be a considerable portion left unfinished, varying all the way from those the bees have not started at all, up to those that are filled with honey, but have a few cells unsealed. Those that have not been worked at by the bees, having no honey at all in them, may be put away until the next year, when they can be used. Be very careful, however, that you do not make the mistake of leaving such sections too long on the hives. When the harvest is over, they should come off at once, for the bees will only daub bee-glue upon them, and sometimes to such an extent that the sections will not be accepted by the bees the following year. Some make a practice of taking off all sections at the close of the clover and linden harvest, so as to have none of the dark honey in them and to avoid the bee-glue being put on them while the bees have nothing to do between the early and late harvests. If a fall flow comes, sections can be again put on, or, better, extracting combs.

Sections that are not entirely finished, will, of course, do for the table, and if they are to be sold, they must be sold at a lower price. Any that are less than half filled with honey, should be fed to the bees. If you set out a super of such sections where the bees can get at them, they would promptly carry out the honey, but would be so eager at this work that they would tear down the tender comb so as to ruin it. Extracting combs are not in the same danger unless they are new. To avoid having the sections ruined for future use, cover them up so as to leave a passage for only one bee at a time to get at them. It is better to set them 10 or 12 rods away from the apiary.

These sections, after being cleaned out by the bees will be valuable for use the next year, and one or more of them, if put in each super that is first placed on the hives, will start the bees promptly at work. If the sections were not cleaned out, the particles of honey remaining would candy and affect the new honey put in them the next season.

JOHN FIXTER.

DIVISION OF BOTANY.

CLOVER OR ALFALFA DODDER.

From time to time inquiries are made by farmers concerning curious leafless, thread-like, fleshy parasitic plants which they find climbing over clover and alfalfa in their fields. The latter plant is also known as lucern. The parasite injures the host plants very much. As a rule only a few patches will be found in a field; but occasionally, as in an instance referred to below, the dodder parasite increased to such an extent that the crop of alfalfa was practically ruined. Specimens of the parasites having been procured through the kindness of Mr. H. H. Miller, of Guelph, Ont., upon examination they proved to be the Clover Dodder, which in this country is more generally known under the name of Alfalfa Dodder. Formerly this species was known as *Cuscuta trifolii*, Bab., from the frequency with which it occurred upon clover (*Trifolium*) in Europe, but it seems to be now generally conceded that it is the same species as was described from plants growing parasitically upon the wild thyme, and for which reason it had been named *Cuscuta epithymum*. There are several kinds of dodders growing in North America; but in Canada it is a small genus consisting of only a few species. Of these there are only one or two which cause injury to crops; and by far the larger number of cases reported are by the Clover or Alfalfa Dodder; this is a European species which has doubtless been brought into this country with the seeds of alfalfa or clover. It does not confine itself to the different kinds of clover, or even to plants of that natural order, but has been found upon a great many different kinds of plants. It is an annual coming up from the seed every year, and in the past the injuries from this parasite have been so small that it would appear as if in many seasons the seed did not ripen sufficiently to allow the plant to increase and become very destructive. It must be remembered, however, that very little alfalfa, which is a long-lived perennial, has up to the present time been grown in Canada, and consequently the only chance which the dodder had to establish itself, was upon Red Clover, which is a much shorter-lived plant and, as a rule, at any rate, is ploughed down after the second year's crop has been taken.

The seeds of dodder would hardly be ripe before the first crop of clover was cut, and its only chance for ripening seed and perpetuating itself would be in those pods which formed low enough to be left on the stubble, or such as were ripe before the second crop of clover was cut in the autumn. The fleshy pods seem to take a long time to ripen; and among those I have examined, there were very few, which seemed dry enough to withstand the September frosts without injury. This, however, is only conjecture, and doubtless in some places further west than Ottawa seed may have ripened this year as it has in previous years to some extent. That this is the case, is shown by the persistence of the plant for two or even three years in a field after it had first been observed. However, such plants may come from seed sown with the clover, of which the germination was delayed; for Mr. H. H. Miller, in a good article upon this subject which was published in the *Farmer's Advocate* for Nov. 23 last, states that 'the seeds will retain their vitality in the soil for five years or longer under favourable conditions. Tests as to vitality have shown that the half-ripe seed of this species will retain sufficient vitality to germinate almost as readily as the fully ripe seed. In some cases, they germinate more quickly; and, when the seeds have been found in their capsules, the percentage of germination was but little inferior to that of well ripened seed.'

5-6 EDWARD VII., A. 1906

The injury done to clover and alfalfa by the dodder is by actually sucking their elaborated sap from them. When the young seed first germinates, a slender yellow thread is pushed up from the soil, which swings round slowly as it grows, and, as soon as this thread touches a living plant, it twines itself around it and throws out from the surface which touches its host, many rootlets or suckers which grow into the tissues of the host plant and draw from it its sap. The host soon becomes dwarfed and in time dies. The dodder plant, however, in the meantime has thrown out a very much branched tangle of fine stems which have spread to other plants in the neighbourhood, from which it is also drawing its nutriment. As soon as the young dodder plant has attached itself to a suitable host, its connection with the soil dries up and ceases. The flowers of the dodder are not produced until the plant has attained a considerable size, when it may form a thick mat from two to four feet across. The flowers are borne in thick conglomerate clusters along the stems and are sometimes so abundant that they almost hide the yellow or reddish stems. Although the plant belongs to the *Convolvulus* family, the tiny five-lobed corolla does not very much resemble the well known shape of the flowers of the Morning Glory. The seed pod, however, and the shape of the contained seeds show the relationship. The separate seeds found in clover seed are variable in size, some being about the same size as Red Clover seed, others much smaller. They are obtusely triangular, of a pale greenish or yellowish brown colour, with the surface finely granulated.

It is probable that the large seeds, nearly as large as those of clover are of a different species from those usually found, which I take to be *Cuscuta epithymum*. Mr. G. H. Clark, Seed Commissioner of the Department of Agriculture, tells me that 'owing to the shortage in the clover seed crop of last year some of our seed merchants imported a lot of clover seed which had originally come from Chili, but was procured through European merchants. This seed was badly infested with Clover Dodder and Wild Carrot. The supply of lucern seed sold in Canada usually comes from Utah, and generally contains some dodder seed. If properly cleaned, however, lucern can be made practically free from dodder seed.'

Mr. Clark also writes me as follows: 'Since discussing the matter of the identity of the different-sized dodder seeds found in clover and alfalfa seed, I have gone more carefully into it and now believe that this recently introduced large dodder seed is *Cuscuta racemosa*, Mart., var. *chiliana*, Eng., of which you will note considerable reference made in the reports of French, German and Swiss botanists as a species of dodder found in clover seed imported from South America. We have been able to secure a specimen of seed that was grown by Dr. Stebler, of Zurich, which he classifies as *racemosa*, and which we believe to be almost identical with the dodder imported into Ontario during the past season. We have yet to learn whether this dodder will stand our Canadian winters, but it seems that *C. epithymum* may become a nuisance in the south-western part of the province of Ontario.'

The following is cited from Mr. Miller's article in the *Farmer's Advocate* and refers probably to the worst occurrence of the Alfalfa Dodder which has ever been noted in Canada:

'As a good example of the injury this weed may accomplish when it once becomes established, let me mention a case in St. Mary's, Ont., where a fifteen acre field of alfalfa was in two years practically destroyed by this weed. The writer had the opportunity of visiting this field several times during the past summer, and through the courtesy of the owner secured the following information: The field was seeded down in 1902 with alfalfa, oats being used as a nurse crop. Conditions being favourable, it gave a beautiful stand in 1903, being cut twice and giving a total yield of about six tons per acre. The first indication of dodder was noticed June 1, 1903, when the owner found about a dozen small round yellowish patches, which he attributed to the bursting of drainage tiles. In about two weeks, however, these had spread so as to attract special attention, and, upon examination, he found masses of tendrils. In 1904 it had spread so as to produce a blight throughout the field. The alfalfa was

SESSIONAL PAPER No. 16

cut once and gave a yield of one and a half tons per acre. In 1905 six acres were cut and gave a yield of about one ton of dodder stems and alfalfa per acre. The remainder of the field was not considered worth harvesting, as the dodder had taken entire possession of the crop.'

The question has been raised as to whether alfalfa badly infested with dodder is fit for food for various kinds of stock. Hearing that Mr. T. Murray Bell, of Otterburn Farm, St. Mary's, had some dodder on his alfalfa, which he had fed to sheep, I asked him to let me know the particulars, which are given in the following letter:—

'St. Mary's, Aug. 13.—I have your favour of the 8th, and as requested I send you three samples of alfalfa with and without the parasite. You ask if this crop is grown for seed here, or merely for hay. In reply, as far as I know, it is merely grown for hay and is cut twice in the season. Yes, we fed our parasitized clover to our breeding ewes all last winter without any evil results, two-thirds of them having twins and an abundance of milk with little or no other feed. We intend doing the same thing this winter. The above mentioned hay was fully mixed with dodder when housed; and, when all was fed up this spring, there was no dodder to be seen anywhere. I believe that, if a field infested with dodder were depastured with sheep after the hay was taken off, little or no dodder would be left afterwards, provided of course that it had not already seeded itself.'

In August last I had an opportunity of discussing with Mr. Miller the occurrences of dodder at St. Mary's, and he obtained for me some heavily infested samples of alfalfa, and also, from the same field and grown on the same soil and under similar conditions, a sample of normal alfalfa which had not been attacked by dodder. These were submitted to Mr. F. T. Shutt, the Chief Chemist of the Dominion Experimental Farms, who has kindly furnished me with the following report, from which it will be seen that, as far as the chemical food constituents are concerned, the dodder-infested hay is of about equal value with the unattacked hay; but it must not be forgotten that the crop per acre is very much less, and above all, that the plants in an infested field are destroyed. This analysis is of value in showing that, when hay is found to be infested, there is no need to follow the general course and burn it, unless it is only occurring in very small patches through a crop.

ALFALFA AFFECTED WITH DODDER.

We received from Mr. H. H. Miller, O.A.C., Guelph, on August 16, three samples of alfalfa, as follows.—No. 1 free from dodder, No. 2 slightly affected with dodder and No. 3 very badly damaged, indeed, practically destroyed, with dodder. All the samples were in good condition.

At the suggestion of Dr. Fletcher, the Botanist, we submitted to analysis Nos. 1 and 3, with the object of ascertaining how far the feeding value of the alfalfa, as revealed by chemical analysis, might be affected by this parasite. In the following table the composition of the alfalfa is given, the results being presented as calculated both on the fresh and water-free material:—

Analysis.

	No. 1. Unattacked.	No. 3. Very seriously affected.
Fresh material—		
Moisture.	73.41	72.24
Protein.	4.91	4.77
Fat or oil.67	.95
Carbo-hydrates.	10.76	13.15
Fibre.	7.84	6.81
Ash.	2.41	2.08
	<hr/> 100.00	<hr/> 100.00

Water-free material—	No. 1.	No. 3.
	Unattacked.	Very seriously affected.
Protein.	18·49	17·19
Fat or oil.	2·51	3·41
Carbo-hydrates.	40·35	47·35
Fibre.	29·50	24·55
Ash.	9·15	7·50
	<hr/>	<hr/>
	100·00	100·00
	<hr/>	<hr/>

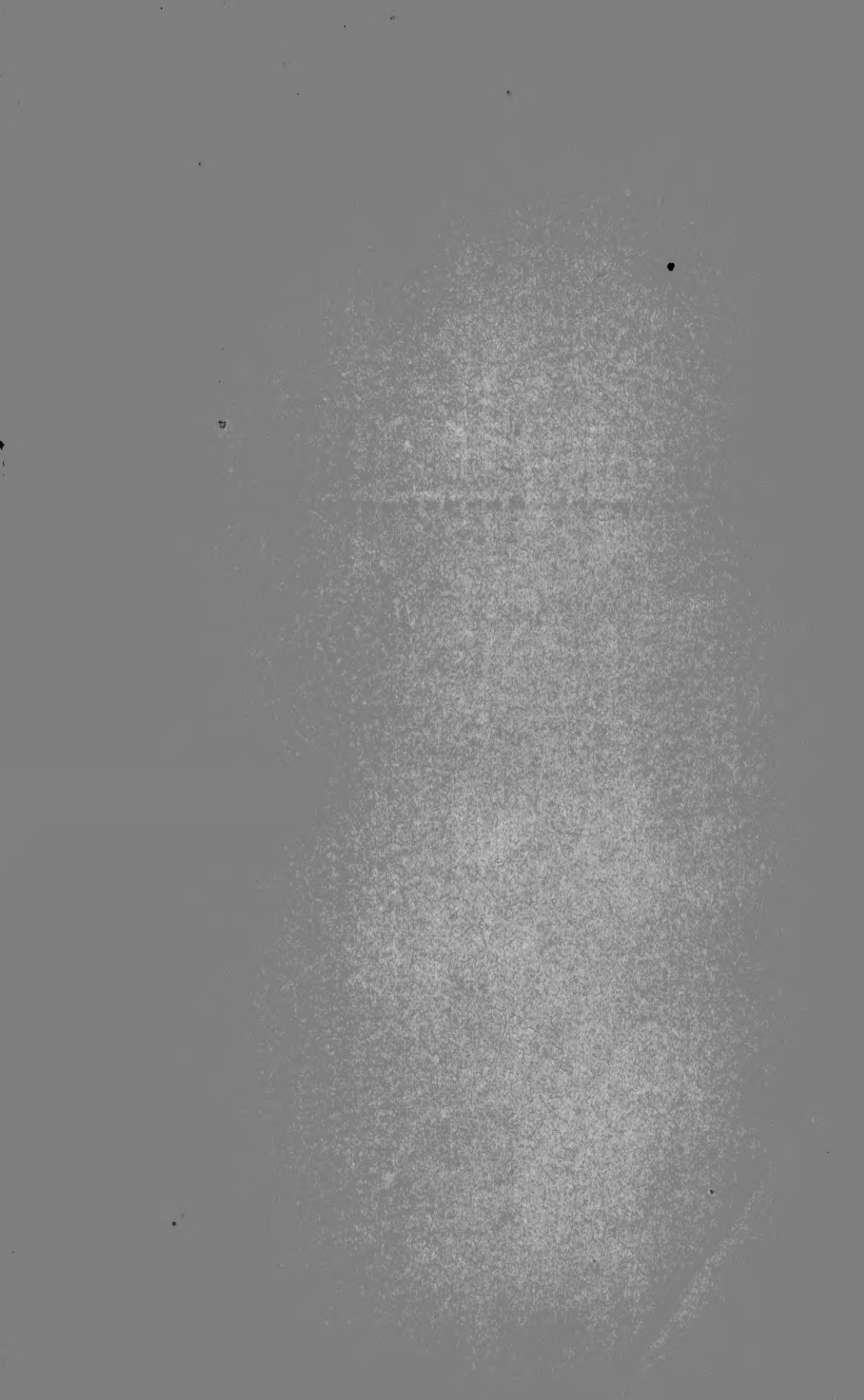
Presuming that the stage of growth of the alfalfa is practically the same in both cases, a comparison of the data should enable us to learn what effect or influence, if any, the dodder has had upon the host plant—alfalfa.

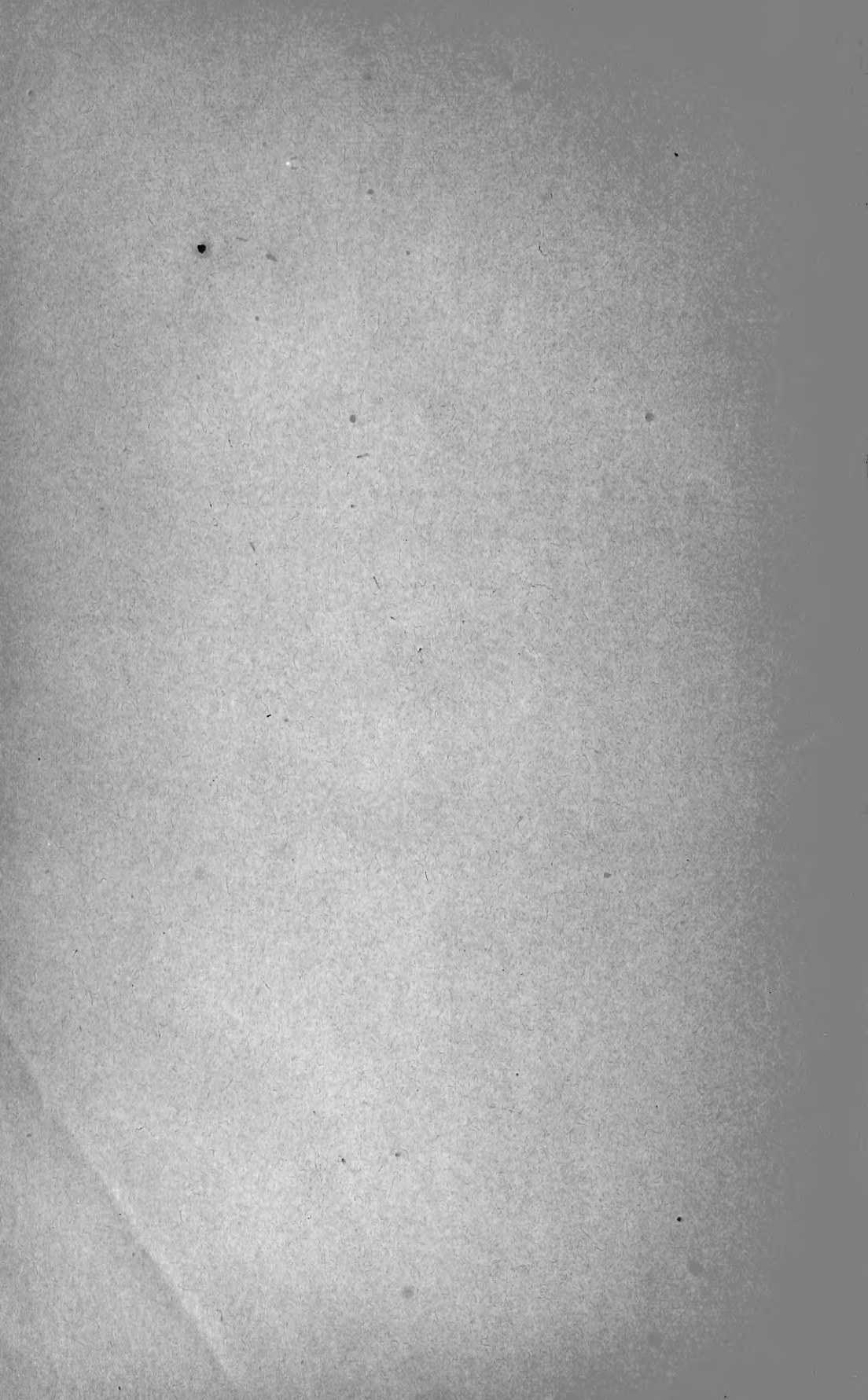
In respect to the most important nutrient, protein, the unattacked alfalfa is somewhat the richer; but the difference is by no means a marked one. The fat, or rather ether extract, includes a certain amount of chlorophyll, so that the slightly higher percentage in the affected alfalfa can scarcely be construed as indicating any superiority. The percentages of fibre and ash are slightly lower in the dodder-affected alfalfa.

It might scarcely be warrantable to draw any conclusion from so few data as to the physiological effect of the dodder; but I think we may safely infer that no great difference in feeding value exists between the dodder-free and dodder-affected alfalfa.

FRANK T. SHUTT,
Chemist, Dom. Exp. Farms.

Eradication.—The chief safeguard against dodder injuring a crop of clover or alfalfa, is to examine carefully all seed purchased and clean out thoroughly all weed seeds before sowing. The dodder seed, when once known, can easily be recognized by its dull surface and triangular shape. When dodder plants are found to be growing in a field the patches should be cut at once and the ground hoed so that no low-growing plants may ripen seed. Burning small areas by putting straw or coal oil over them is said to be effective, but would be less convenient than hoeing out the infested plants. Where a whole field has been thoroughly infested, it should be put under a short rotation in which clover for hay is omitted for at least two rotations, as it is claimed that the seeds will remain in the soil for five years without decaying; therefore, some of the seeds of the original sowing, particularly if these were rather dry, might be delayed in germinating for that time. As stated above, it is only quite recently that dodder has occurred in Canada in sufficient quantity in crops to do extensive harm; but, with the increasing cultivation of alfalfa, it is of course possible that it may become a more frequent enemy of farmers. It is therefore important that its habits and appearance should be known as soon as possible.







1905

SMITHSONIAN INSTITUTION LIBRARIES



3 9088 01491 7454